# SCIENCE ABSTRACTS.

## Section A.—PHYSICS.

JULY 1905.

## GENERAL PHYSICS.

**1327.** *Improvements in the Condensation Hygrometer.* **F. Michel.** (Zeitschr. Instrumentenk., Beib. 5. pp. 44–45, March 1, 1905.)—A Regnault hygrometer is connected to a stout tube which passes to the bottom of a Wolff's bottle containing ether. The top of the bottle is connected through a second neck to a small condenser within the hygrometer and to a rubber bulb, the connections with the bottle being made air-tight. By means of the bulb, the hygrometer can be mechanically filled with ether, whilst the mixture of air and ether, in passing off, is employed to cool the incoming current of air, much less ether being given off by the apparatus than by the ordinary form of the hygrometer. G. E. A.

**1328.** *Method of Obtaining the Vertical on Board Ship.* **G. A. Crocco.** (N. Cimento, 9. pp. 224–226, March, 1905.)—The author describes a modification of the ordinary pendulum, by which the disturbing effect of the rolling of the ship is eliminated. Two elastic connections are made, from fixed points on the ship to the opposite sides of the pendulum. As the ship rolls, the stretching and contracting of these connections produce forces which may be made to balance those brought into play by the rolling of the ship. On the assumption that the pendulum is small compared with its distance from the axis of rolling, the relation between length of pendulum, distance of attachment of elastic connections from point of support, distance of pendulum from axis of rolling, periodicity of rolling and acceleration of gravity is found which will reduce the equation of motion of the pendulum to one whose solution is of the simple harmonic type. S. G. S.

**1329.** *Automatic Damping Device.* **V. Crémieu.** (Comptes Rendus, 140. pp. 1029–1031, April 10, 1905.)—The disadvantages attached to liquid or magnetic damping arrangements are avoided in the apparatus described. The top of a pendulum consists of a flat cylindrical hollow case within which a loaded disc is pivoted, the pivots inside being in line with the knife-edges outside the case. The remainder of the cavity is completely filled with a viscous liquid, the arrangement thus forming a pendulum within a pendulum. G. E. A.

1330. *Electromagnetic Arrangement of Foucault's Pendulum Experiment.* **P. Spies.** (Phys. Zeitschr. 6. pp. 345–346, June 1, 1905.)—The bob is furnished with a point which, as the plane of swing shifts, makes contact first with one piece of platinum-foil, and then with another; these contacts allow the passage of a current down the pendulum, and thus the registration of the times of the contacts, so that the rate of relative shift of the plane of swing can be determined. R. E. B.

1331. *Harmonic Analysis.* **S. P. Thompson.** (Phys. Soc., Proc. 19. pp. 443–450; Discussion, pp. 451–453, April, 1905.)—The method described by the author is intended for use with functions containing only odd harmonics, and consists essentially in a special mode of grouping the various ordinates of the curve to be analysed. The saving of labour thereby attained is considerable as compared with other methods. Two schedules are given, one for the analysis of a function containing only odd harmonics up to the 11th, and another for functions not containing any harmonics beyond the 5th. In the *discussion,* **J. A. Fleming** described an instrument for the synthesis of functions from given harmonic constituents, and **J. Harrison** pointed out that the author's method could be carried out entirely by graphical means. [See also the author's "Harmonic Analysis Reduced to Simplicity," Electrician, 55. pp. 78–80, May 5, 1905.] A. H.

1332. *Viscosity of Air.* **J. L. Hogg.** (Amer. Acad., Proc. 40. 18. pp. 611–626, April, 1905. Contribution from the Jefferson Phys. Lab., Harvard University.)—The values hitherto obtained for the viscosity of air at 0° vary between 0·000168 and 0·0001767. [See Abstracts Nos. 1616, 2079 (1901), and 2456, 3157 (1904).] In the present method the decrement of vibrations of spheres and discs is measured. The discs are of two materials, of which one is two or three times as dense as the other, and the dimensions of two discs employed are such that a pendulum made up with a sphere and light disc has the same period as one made with the heavy disc alone, and the difference of the decrements of the two pendulums is due to the resistance of the air on the sphere alone. Spheres of ivory (0·87 cm. diam.) and of glass (1·5 cm.) were vibrated at the end of a quartz fibre 35 cm. long. The mean value found was 0·0001713, the extremes being 0·0001716 and 0·0001709. G. E. A.

1333. *Poiseuille's Law at Low Rates of Shear.* **A. W. Duff.** (Phil. Mag. 9. pp. 685–692, May, 1905.)—To produce the low rate of shear use a large tube (3 mm. diam.) and have a very small head of water (1 mm.). Two large beakers are connected by this tube. The small difference in level is produced by immersing a steel cylinder in one beaker. In some cases the tube was silvered. The conclusions are: (1) Poiseuille's law holds true to within 1 per cent. for pure water and kerosene, between rates of shear of 5 and 500,000 radians per sec. in the case of water, and between 0·2 and 20,000 radians per sec. in the case of kerosene; *i.e.,* the coefficients of viscosity are constant between those limits. (2) Very minute quantities of glass dissolved by water have very large effects on the viscosity at the low rates of shear. This is proved by having the water in the tube for variable times. (3) Differences of rates of shear do not seem to account for the lack of perfect agreement between different methods of measuring viscosity. Water and kerosene do not afford any support for the view that at low rates of shear liquids may approximate in condition to plastic solids. P. E. S.

1334. *Cylinders for Compressed Gases.* **A. Martens.** (Zeitschr. Vereines Deutsch. Ing. 49. pp. 604–609, April 15, 1905.)—Deals with the permissible stresses in cylinders for compressed gases, and with questions of modes of testing and treatment. The view is taken that initial raising of the elastic limit of the material by hydraulic pressure sufficient to permanently stretch the cylinders is a permissible mode of increasing the safe working pressure, but the official testing of each individual cylinder by hydraulic pressure exceeding the proposed working pressure is not recommended. As a preferable mode of procedure it is suggested that a few cylinders chosen at random from a batch should be tested to destruction by direct hydraulic pressure and the material tested after fracture. The value of annealing at intervals is discussed, with the conclusion that reheating processes are distinctly harmful where the elastic limit of the material has been artificially raised by working at temperatures below 700° C. W. Ros.

1335. *Relation between Compressive Stress and Permanent Strain in Iron and Steel.* **W. C. Popplewell.** (Manchester Lit. and Phil. Soc., Mem. 49. 7. pp. 1–18, April 18, 1905.)—The author found that T. E. Stanton's expression for tensile strain, $p = Ce^k$ (where $p =$ stress, $e =$ permanent strain, and C and $k$ are constants for a given material) holds also for various metals in compression. In the present paper tests on iron and steel are described, measurements of strain being taken either from end to end of the piece or between marks. The values found for $k$ are in some cases greater and in others less than the value 0·25 in Stanton's tension experiments; the values of C are greater than in the latter. F. R.

1336. *Action of the Forging Press, and the Compression of Metal.* **Demozay.** (Soc. d'Encouragement, 107. Rev. de Métallurgie, pp. 277–296, April 30, 1905.)—Roughly parabolic curves were found to represent the connection between pressure and reduction of thickness of ingots forged in a hydraulic press. The curves have greater curvature in each succeeding pass, accompanied by a decreased expenditure of energy. This is attributed partly to deformation becoming easier under increasing stress, in the usual way of plastic materials, and partly to the possibility that the press first produces deformation of the external cooler parts of the ingot, and, later—because the force is not transmitted instantly—of the more malleable interior. The nature of the curves points to the conclusion that forging should be accelerated. Accepting a parabolic relation as above, the author deduces that the energy required to displace unit volume of material by compression is proportional to the maximum pressure per unit of compressed surface, and he applies the result in considering the reduction desirable at each pass in the case of rolling. F. R.

1337. *Rigidity of Gelatine.* **H. Morris-Airey.** (Manchester Lit. and Phil. Soc., Mem. 49. 4. pp. 1–10, April 18, 1905.)—In the apparatus used by the author, by varying the head of a liquid, the pressure on one side of the jelly investigated can be varied; the distortion is measured by the motion of a mercury column in the capillary tube. The coefficient of rigidity, $\eta$, of the jelly is given by the expression $\eta = R^4 g\rho h/8lmr^2$, where $h$ is the variation in the head of the liquid producing the pressure, $\rho$ the density of this liquid, $m$ the distance through which the end of the capillary column moves, $r$ the radius of the capillary tube, and $l$ and R the length and radius of the cylinder of jelly. The accuracy of the above formula is confirmed by experiment. The coefficient of rigidity of a 5 per cent. gelatine solution at first increases, and reaches a steady state about eight days after the solution is placed in the tube, the value of $\eta$ being then $4{\cdot}64 \times 10^4$ c.g.s. units. Within an hour of filling the tube the jelly behaves like a very viscous liquid. After two hours it shows but little viscosity, but possesses hysteresis to a marked extent, the plug exhibiting a permanent strain after pressure is removed. This hysteresis effect becomes less marked as the solidification goes on, until, about twenty hours after the preparation of the tube, it suddenly disappears, further alteration in the rigidity being very slow and often quite inappreciable after several days. This behaviour seems to confirm the nucleus theory of solidification; the hysteresis disappears when the nuclear globules come into contact and grow together, since the deformation under pressure will then be a purely elastic one. The addition of salts to the jelly causes a smoothing of the $\eta$-time curve, which indicates the presence of an increased number of nuclei, presumably the electrolytic ions. Non-ionising substances, such as sugar, produce no such smoothing.

T. H. P.

1338. *Influence of Tenacity on the Capillary Constants of Acetic Acid-Water Mixtures.* **L. Grunmach.** (Boltzmann Festschrift, pp. 460–468, 1904.)—Mixtures of acetic acid and water show a maximum density at 78 per cent. acetic acid; the fluidity slowly decreases with increase of concentration to a minimum at 77 per cent. and then rapidly increases. Solutions can be prepared which with the same density have different tenacities; these are very suitable for investigating the effect of tenacity on the capillary constant. By means of the capillary ripple method all acetic acid solutions were found to show diminutions of specific cohesion and surface tension with increase of concentration, so that no regular relation between tenacity and surface tension can be deduced. Of two solutions of equal density and wave frequency, that containing the larger amount of acid has the lower surface tension. Near the point of maximum contraction there is a sudden small drop in the curve of the capillary constant.

L. H. W.

1339. *The Bubble Atom.* **J. Fraser.** (Roy. Soc. Edinburgh, Proc. 25. pp. 680–716, 1904–1905.)—In a previous paper [see Abstract No. 2012 (1902)] the author develops a theory of the constitution of matter; the ether is supposed to consist of small, perfectly globular, smooth, hard, elastic particles, while the atoms of matter are bubbles in the ether, the inside being a perfect vacuum. The bubbles do not collapse under the ether pressure, because of the rapid revolution of the ether particles in the skin of the bubble round its centre. In the present paper the author develops the theory so as to account for the best-known phenomena in electricity. In atoms of different elements the ether particles in the skin have different speeds. If two elements are rubbed together, the one having the greater skin-speed loses speed, and the one having less skin-speed gains speed equally; the former is then negatively and the latter positively electrified. The stresses produced in the ether by these changes in speed would be directed along the lines of force round the charged elements. Increase of speed energises the ether more, and decrease of speed energises it less, than normal. Attraction and repulsion between charged bodies is then accounted for. The author embraces in his explanation the phenomena of current electricity, specific inductive capacity, specific resistance, &c.

P. E. S.

1340. *Observations on Coronas produced by Condensation.* **C. Barus.** (Amer. Journ. Sci. 19. pp. 349–356, May, 1905. Paper read before the Amer. Physical Soc., Feb. 25, 1905.)—A description is given of the observations made on the alternations of large and small coronas which occurred in the case of identical condensations produced in dust-free air saturated with moisture. The author concludes from his experiments that dust-free air is inseparably intermixed with large and small nuclei, whose numbers (millions per cub. cm.) rapidly increase as the order of molecular size is approached. He looks upon these nuclei as a kind of colloidal (air) molecule, such molecules being frequently producible by the means which produce nuclei. When a large number of free atoms are suddenly introduced into any region, the result is not merely a production of typical molecules, but of a large concomitant of graded nuclei. Practically any given nuclear status of air is a counterpart of the intensity of the ionisation of the medium in which the nucleation originated, to the effect that the superior limit of size of the nuclei and their number increase with the ionisation. But there is no case of ionisation free from nucleation, whatever the exciting cause, the two manifestations being often distinguishable by enormously different rates of decay. J. J. S.

1341. *Inertia Coefficients of Aspiration Thermometers in Atmospheres of Varying Densities.* **J. Maurer.** (Zeitschr. Instrumentenk. 25. pp. 118–119, April, 1905. Meteorolog. Zeitschr. 21. p. 489, 1904.)—When balloons move rapidly through air, a correction has to be made consisting of the inertia coefficient multiplied by the differential quotient of the temperature. In how far the coefficient depends upon the density of the atmosphere had not yet been determined. The author made experiments with the aid of the 110 h.p. compound engine of the engineering laboratory of the Zürich Polytechnic. The machine can extract 82 litres of air per sec. An aspiration thermometer, which at ordinary pressure and normal aspiration (4 m. / sec.) agreed with a Hergesell tubular thermograph, was placed within a ventilating tube 8 cm. diam., the aspiration regulated to the normal figure (4 m. / sec.), and the temperature determined at intervals of about 10 sec. It results that the inertia coefficient increases as the pressure goes down to 400 mm., slowly at first from 0·84 to 0·87, then more rapidly; the coefficient has about double its original value when the air pressure has diminished to 60 mm. No formula can so far be given, but for the greatest heights reached, about 20 km., the correction would, for a Hergesell thermograph, amount to 2° C. Notes are added concerning the balloon ascents made from Zürich on the international days. Assmann's rubber balloons and Hergesell's barothermographs are used. Bourdon tubes are found preferable to aneroids, and the author has improved the clockworks by introducing invar (nickel steel); ordinary clockworks are apt to stop at −50° C, while the new clocks have stood −70° C. H. B.

1342. *Variations of Pressure in North-East Africa and the Nile Flood.* **H. G. Lyons.** (Roy. Soc., Proc. Ser. A. 76. pp. 66–86, April 22, 1905.)—It was formerly believed that the White Nile contributed materially to the Nile floods. It is now known that the volume of the White Nile is held back by the Blue Nile when in flood, and that the White Nile supply is negligible until the discharge of the Blue Nile falls, about October, below 3,000 or 4,000 $m.^3$/sec. The meteorological conditions on the Abyssinian plateau determine the rainfall which supplies the annual flood of the Nile. The Abyssinian rains, which are heaviest in the months of June to September, take 25 days in July and 15 days in September to reach Aswan. Comparing the pressure distribution which, the author points out, is very different in Egypt and the Sudan from that usually assumed in meteorological atlases, with the Nile floods, the author finds that generally speaking the curve of the Nile floods varies inversely as the mean barometer pressure of the summer months over the wide area from Beirut to Mauritius and from Cairo to Hong-kong; this would be Lockyer's Indian type of curve, and Bigelow's direct type. Sometimes, however, pressure at Beirut and Cairo differs from that of the rest of the area (Cordoba or indirect type), and Egypt would thus appear to belong to Brückner's class of temporarily exceptional areas. The monthly means show these relations best; pressure above the normal in the rainy season of Abyssinia coincides with deficiency of rainfall. On these lines, in the 35 years 1869 to 1903 very fairly accurate predictions of the flood could have been made from month to month in six out of seven cases. But the mean relative humidity in June and the prevalence of southerly winds in April and May are not safe guides for flood prediction, and W. Willcocks' forecast of a good flood for 1904, based on those considerations, failed; nor is the connection between Abyssinian rainfall and the south-west monsoon of India so close as W. Willcocks and J. Eliot have assumed. H. B.

**1343.** *Boring of the Simplon Tunnel, and Temperature Distribution in it.* **F. Fox.** (Roy. Soc., Proc. Ser. A. 76. pp. 29–33, April 22, 1905.)—Horizontal holes, 1·5 m. deep, were bored in the side of the tunnel 1,000 m. apart, and permanent thermometers inserted in them. The tunnel length is 19·73 k.m., the maximum height of the rock above it 2,135 m., the maximum temperature of the rock 54·5° C. While the rapid advance of the Brandt hydraulic drills, 5·48 m. daily for months, favoured reliable observations, the excellent ventilation of the tunnel, and the draining of the water from the hot springs encountered, complicated matters. In the months July to September, 1904, 5,295,450 m.$^3$ of air were introduced into the tunnel, 33·9 m.$^3$/sec. from Brigue and 27·3 m.$^3$ from Iselle; the average temperature of this air was 17·5° C., in the advanced headings it rose to 27·1 and 29·7° C. In order to show the rapid cooling of the rock after perforation, the author gives the temperatures for March, 1901, 1902, 1903, 1904, for four points on each tunnel side, north and south. At the southern side the temperature follows approximately the increasing altitude of the mountains until the altitude of 2,200 m. is reached; then the temperature falls. Between that, km. 8 and 13, the temperature gradient in the rock would be 37 m. per 1° C. (67·5 ft. per 1° F.). H. B.

**1344.** *Solidification of the Earth.* **A. Leduc.** (Comptes Rendus, 140. pp. 899–901, March 27, 1905.)—The writer criticising a recent article by Lœwy [see Abstract No. 945 (1905)] suggests that the well-known laws of contraction or expansion on solidification may only be applicable to simple bodies or definite mixtures, and not in cases of such complex bodies as form the mass of this and other planets, of which the solidification commences after superficial cooling. Moreover, the solidified portions of such a mixture would not necessarily have the same composition as the initial liquid magma, and the whole question must be still more complicated if the original magma be considered as made up of layers or shells of varying densities. C. P. B.

**1345.** *Comparative Luminosity and Total Radiation of Solar Corona.* **S. P. Langley.** (Astrophys. Journ. 21. pp. 194–195, March, 1905.)—The author stated in his report on eclipse of May 28, 1900, that the luminosity of the inner corona, as compared with its heating effect, is so great that it is difficult to attribute the coronal radiation to the incandescence of particles of matter made hot by proximity to the sun. Arrhenius differed from this [see Abstract No. 19 (1905)], and computed that the incandescent particles observed by the bolometer might maintain a temperature of about 4,620° abs. The author criticises this view, saying it takes no account of the fact that the observed coronal effect is an integrated one from all parts of the corona along the line of sight, and that the bolometer strip was of such dimensions that considerably varied portions of the corona were effective. C. P. B.

1346. *Stellar Temperatures.* **W. E. Wilson.** (Roy. Dublin Soc., Trans. 8. 15. pp. 183–186, March 24, 1905.)—Discussing the several schemes of stellar classification based on the spectroscopic differences found in various stars, the author describes an experiment which he considers to prove that spectral variations may be produced by other causes than temperature, and formulates a method of reasoning to account for the phenomenon of sunspots. Premising that the solar photosphere may be due to incandescent carbon clouds, the spectra of stars like Sirius may be explained by thinking that only elements like hydrogen, with atomic weights less than carbon, can rise above it and indicate their presence by dark absorption lines. He then considers stars of Group IV. to be of higher temperature than the sun, and that Sirian stars owe their great brilliancy, not to very high temperature, but to their deep photospheres. C. P. B.

1347. *Temperature of Solar Atmosphere.* **A. Schuster.** (Astrophys. Journ. 21. pp. 258–260, April, 1905.)—A reply to adverse criticism of a former article. The chief point at issue is with respect to the location of the absorbing layer. The amount of radiation necessary showed that the absorbing layer must have a temperature not very much less than that of the photosphere. In the former paper an error occurred in the temperature equation, which should have been stated to vary as the *fifth* power of the maximum radiation, instead of the *fourth.* In recalculating this the temperature of the photospheric layers works out at 6,700°. and 5,450° for that of the absorbing layer, and the author concludes that, "There is a stratum near the sun's surface having an average temperature of approximately 5,500° C., to which about 0·3 of the sun's radiation is due. The remaining portion of the radiation has an intensity equal to that due to a black body having a temperature of about 6,700° C." [See also Abstract No. 1309 (1904).]
C. P. B.

1348. *Spectrum of $\mu$ Centauri.* **N. Lockyer** and **F. E. Baxandall.** (Roy. Soc., Proc. 74. pp. 548–550, April 10, 1905.)—From a study of Pickering's photograph of the spectrum of $\mu$ Centauri it has been found that most of the chief bright lines—other than those of hydrogen—occupy positions closely corresponding to those of the most conspicuous enhanced lines of iron. Among the brightest lines in the spectra of Novæ at their initial stages are lines agreeing in position with the most marked $\alpha$ Cygni and enhanced Fe lines, and in this way a resemblance can be traced between the minor bright lines of $\mu$ Centauri and the most conspicuous bright lines—other than those of hydrogen—in the early spectra of Novæ. C. P. B.

1349. *Unknown Stellar Line* λ4686. **N. Lockyer** and **F. E. Baxandall.** (Roy. Soc., Proc. 74. pp. 546–547, April 10, 1905.)—During the preparations for the solar eclipse of 1898 a photograph was obtained of the spectrum of a sample of helium in a vacuum tube, on which was found an outstanding strange line at λ4686·97, for which no terrestrial origin could be found. The line is fairly prominent in the spectrum of the chromosphere as photographed during total eclipses, and may be in some way associated with helium. A line of about this wave-length has also been recorded in other celestial spectra, notably in bright-line stars, nebulæ, stars of the Orion type, and stars similar to β Crucis. Rydberg has suggested that a line near 4686 in stellar spectra, to which he gives the wave-length 4687·88, may be the first line of the principal series of hydrogen, and it may be possible that his computed value is slightly in excess. Further experiments are advisable for throwing light on this point. C. P. B.

## REFERENCES.

1350. *Apparatus for Measurement of Time, Lengths, Velocities, and Accelerations.* **J. Carlier.** (Soc. Belge Élect., Bull. 21. pp. 329–414, July; 439–506, Aug.; 531–594, Sept.; 668–706, Oct.; 766–783, Nov.; 811–864, Dec., 1904; 22. pp. 31–58, Jan.; 73–133, Feb.; 156–222, March; and pp. 245–276, April, 1905.)—This series of papers contains an exhaustive illustrated treatment of the theory and practice of measuring the above quantities. The following instruments are described: measuring chains, tapes, spherometers, calipers, micrometers, cathetometers, and verniers; planimeters, instruments for determining the mean ordinate of a curve (Coffin's averaging instrument, Graham's screw, Bagshaw's compass). Sundials, clock and watch escapements, electric clocks, astronomical clocks, stop-watches, chronographs. Tachometers, telemeters, revolution-counters, speed-indicators, tachymeters, pressure-gauges, apparatus for measuring the velocity of gases, integrators, stroboscopes, ergmeters, apparatus for measuring the speed of trains, trams, and other vehicles. Combined apparatus for registering time, speeds, and distances. Logs, relative speed indicators, instruments for measuring the slip of alternate-current motors. Apparatus for indicating and registering variations of speed. Apparatus for indicating and registering accelerations; dynamometers. C. K. F.

1351. *Driving Screws of Photographic Telescopes.* **E. S. King.** (Science, 21. pp. 410–414, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—Starting with a statement of the extreme accuracy of driving required in the clock train of photographic telescopes, the author describes the performance of several well-known telescope mountings, and gives suggestions of various methods of testing the nature and amount of any periodic error which may be found. C. P. B.

1352. *Sliding-Weight Barograph.* **A. Sprung.** (Zeitschr. Instrumentenk. 25. pp. 37–45, Feb., and pp. 73–82, March, 1905.)—The theory and practice of a balance-barograph, an improvement of a form brought out by the author in 1877, involving the use of a wheel running on the beam of the balance and carrying the pen; change of pressure causes a motion of the beam, and the wheel is kept at the equilibrating position by means of electromagnets. G. E. A.

1353. *Form of Notch for Brittleness Tests.* **F. Barbier.** (Génie Civil, 46. pp. 361–363, April 1, 1905.)—Experiments upon several steels by the Frémont method [see Abstract No. 695 (1905)] showed very little difference in rupture work according as the notches were made by new as against worn saws, or between a rounded notch formed by drilling and filing as compared with a machined square notch. F. R.

1354. *Special Theodolite for Balloon Observing.* **A. de Zuervain.** (Zeitschr. Instrumentenk. 25. pp. 135–137, May, 1905.)—An instrument specially designed for visually following the small balloons used for meteorological observations is described and its advantages pointed out.

1355. *Model Experiments on Hollow* versus *Straight Lines.* **R. E. Froude.** (Engineering, 79. pp. 521–525, April 21, 1905. Paper read before the Inst. of Naval Architects, April 13, 1905.)—Results of experiments in smooth water with models of usual size, and of others with artificial waves and smaller models.

1356. *Effect of Acceleration on Ship Resistance.* **C. E. Stromeyer.** (Engineering, 79. pp. 525–526, April 21, 1905. Paper read before the Inst. of Naval Architects, April 13, 1905.)

1357. *Application of a Pitot-Darcy Tube.* **H. Bellet.** (Comptes Rendus, 140. pp. 1531–1532, June 5, 1905.)—A Pitot-Darcy tube has been applied for the purpose of measuring the velocity of the flow of water under pressure. To make the apparatus more sensitive it has been provided with a U-tube to indicate the difference in pressure. The tube contains a liquid non-miscible with water, such as carbon bisulphide coloured with iodine. W. W. H. G.

1358. *Review of Maunder's Recent Investigations on the Cause of Magnetic Disturbances.* **C. Chree.** (Terrestrial Magnetism, 10. pp. 9–14, March, 1905.)—The author regards Maunder's theory [see Abstract No. 1185 (1905)] as incomplete, and wholly erroneous possibly, but exceedingly suggestive. He criticises several points. The recurrences of spots after an absolute rotation of the sun (period of 27–28 days) are doubtful, the commencements of magnetic disturbances very uncertain, and the differences in the intensity and duration between the earlier and later storms of Maunder's sequences not distinct. Schuster's periodograms, moreover, rather gave a period of half a solar day than of a whole day. H. B.

1359. *Radial Velocities of Polaris, η Piscium, ε Aurigæ, and β Orionis.* **W. W. Campbell** and **H. D. Curtis.** (Astrophys. Journ. 21. pp. 191–193, March, 1905.) —Reductions of numerous spectrograms show that Polaris is a triple system changing in a very regular manner, with a period of at least eleven or twelve years. The plates of η Piscium do not *certainly* show variation of velocity. The variable velocity of ε Aurigæ is confirmed, period probably several years. β Orionis shows no definite signs of variable velocity. (Ibid. pp. 185–190). A list is given showing data for nine further examples of stars showing evidence of variable velocity. [See also Abstract No. 2145 (1904).] C. P. B.

1360. *Variable Radial Velocity of Sirius.* **W. W. Campbell.** (Astrophys. Journ. 21. pp. 176–184, March, 1905.)—The results of measures on 31 spectrograms of the spectrum of Sirius taken since 1896 are tabulated. The velocity of the system is given = $V_m = -7{\cdot}36$ km. per sec. C. P. B.

1361. *Co-ordination of Visual and Photographic Star Magnitudes.* **J. A. Parkhurst.** (Science, 21. pp. 417–419, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—It is becoming increasingly important to find some co-ordinated method of harmonising visual and photographic magnitudes for stars differing both in type of spectrum and colour. The chief difficulty lies in the estimation of colour. The author suggests that a deal may be done with suitably-selected isochromatic plates and a reflecting telescope of truly achromatic performance. C. P. B.

1362. *Canals of Mars.* **P. Lowell.** (Science, 21. pp. 416–417, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—By tabulating comparisons of the observations of Schiaparelli in 1888, and Lowell in 1903, the author shows the probable truth of the measures by the three points: (1) The fact of similar formations showing double to both observers; (2) the agreement in relative widths of the double canals; (3) the agreement as to their absolute widths. C. P. B.

1363. *Quadruple System of a Geminorum.* **H. D. Curtis.** (Science, 21. pp. 419–420, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—Recent photographs obtained with the Mills spectrograph of the Lick Observatory are described. The period appears to be about 27 days. With the proper exposure from 15–25 measurable lines are obtained. The total range in radial velocity is about 21 km., and the velocity of the centre of mass is approximately + 5 km. per sec. C. P. B.

1364. *Variations of Bright Hydrogen Lines in Stellar Spectra.* **A. J. Cannon.** (Science, 21. pp. 414–415, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—Details of variations in the intensities of the bright hydrogen lines of six stars of the Orion type are given. So far as is known, no variation in the light of any of these stars has hitherto been detected. C. P. B.

1365. *Monochromatic Radiation of Orion Nebula.* **J. Hartmann.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 16. pp. 360–368, March 23, 1905.)—Photographs of the ultra-violet spectrum of nebulæ, taken with a quartz spectrograph, have shown many more lines than were shown with the glass spectrographs. The ultra-violet line at λ3727 is so strong that for photographic purposes the light of the nebula is practically monochromatic. When using isochromatic plates the photograph may be taken in monochromatic light of the wave-length of one of the other strong nebula lines by the use of suitable colour filters. [See also Abstract No. 29 (1903).] C. P. B.

1366. *Rumford Spectroheliograph of Yerkes Observatory.* **G. E. Hale.** (Astrophys. Journ. 21. pp. 261–270, April, 1905.)—The author replies to various opinions which have been expressed on a former paper dealing with the physical interpretation of photographs obtained with the spectroheliograph. A spectrum of the solar surface is given showing how the continuous spectrum of a facula rapidly decreases as it approaches the centre of the broad lines, H and K, of calcium. C. P. B.

1367. *Formation of the Moon.* **G. Romanes.** (Roy. Soc. Edinburgh, Proc. 25. pp. 471–479, 1904–1905.)—A series of suggestions are outlined on the idea that the lunar formations may be the result of impacts from outside objects falling on the moon's surface in consequence of its gravitational attraction. These may have been of all sizes up to 20 miles diameter, and the general depression of the floors of most of the craters which are not near the Maria is considered to support this view. Illustrations are given of the cavities formed in a mass of lead by a series of leaden bullets fired at various angles of incidence. The holes were always considerably larger than the bullet, and had a circular section whatever the angle of fire. C. P. B.

## LIGHT.

**1368.** *A Scale of Colour Values and a New Photometer.* **A. H. Munsell.** (Technology Quarterly, 18. pp. 60–72, March, 1905.)—A scale of grey tints having been chosen, a photometer was constructed, the essential idea of which is that if a white card be properly safeguarded from stray light, and its illumination controlled by a suitable shutter, it may be made to trace the complete scale of the above grey tints from white to black. The sample under test is placed alongside the card in a separate camera under constant illumination; the card is illuminated through a shutter of square shape, of which the aperture is adjusted to produce equality of tint. The instrument is provided with an eye-piece, and the motion of the shutter is made by means of a hand on a dial divided into 100 equal parts. The calibration of the dial and method of using the instrument are briefly described, and it is shown how the instrument may be employed to determine the value of reflected or transmitted colour, the candle-power of a source, the diffused light of a room, and the relative sensitiveness of each eye to light and colour. The instrument forms part of a new system for the identification of colour by measured scales of "hue, value, and chroma," *i.e.*, of wave-length, amplitude, and wave-form. G. E. A.

**1369.** *White Walls in a Photometric Laboratory.* **E. P. Hyde.** (Elect. World and Engineer, 45. pp. 1084–1085, June 3, 1905.)—It is usually considered essential in accurate photometric work to have the walls, &c., of a photometer room as nearly "dead" black as possible. Experiments were carried out by the author in the photometric laboratory of the Bureau of Standards to determine the magnitude of the error introduced by having white walls. The room was 29 ft. × 19 ft. × 12 ft. high. A Lummer-Brodhun photometer was used, and diaphragms covered with black velvet placed in the path of the rays prevented practically all the light except that coming from the lamp under test, or by reflection from the diaphragms, from reaching the photometer head. The method of measurement is by "double weighing," so that all want of symmetry between the two sides of the photometer is eliminated. Under these circumstances it was found that the effect of the white walls in introducing errors in the measurements was entirely negligible. A. R.

**1370.** *Preparation of Iron Mirrors by Dust Deposition.* **V. Biernacki.** (Ann. d. Physik, 16. 5. pp. 943–950, May 16, 1905. Phys. Lab. des Polytechn. Inst., Warschau, March, 1905.)—An iron strip is made bright red by means of a current, a glass plate to receive the deposit being hung above the strip within an evacuated space. Iron precipitated in this way exhibits strong retentivity, being in this respect distinct from the iron from which it originated. From chemical tests it would appear that the layer is not composed of oxide. The reflecting power of such iron mirrors is about 62 per cent. of that of silver, which is also the value for mirrors of polished iron. The refractive indices of the deposits for red and blue light, found by investigating the elliptical polarisation of a reflected ray which is incident as a plane polarised ray, were 2·83 for red and 1·89 for blue light. G. E. A.

1371. *Test of a Transit Micrometer.* **J. F. Hayford.** (Science, 21. pp. 408–410, March 17, 1905. Paper read before the Astron. and Astrophys. Soc. of America, Dec. 27–30, 1904.)—When working with the new transit micrometer, in which the observer keeps the star continually bisected by the moving wire, the element of personal equation is so nearly eliminated that it becomes extremely difficult to prove that either the personal equation or its variation are not exactly zero. Various attempts have been made to render this method of observation practicable, notably by Braun of Kolocsa in 1865, Repsold in 1899, and Fischer in 1903–1904, the latter having designed and constructed a very efficient instrument for the Coast and Geodetic Survey. This is a hand-driven micrometer. In the tests sixteen observers were engaged, amongst whom were persons of long experience, others with no previous experience, and others with slight knowledge of the operations involved. It was found that the observations could be made by any of the sixteen with an accuracy equal to that of observing a stationary object, and there was difficulty in detecting systematic errors of any kind. The author considers that three nights' observations, without exchange of observers, with the new instrument are equal to ten nights and exchange under old conditions. C. P. B.

1372. *Reflecting Powers of Glass and Silvered Glass Mirrors.* **C. A. Chant.** (Astrophys. Journ. 21. pp. 211–222, April, 1905. Paper read before the Roy. Astron. Soc. of Canada.)—The author first presents a review of former investigations on the reflecting power of various substances. For perpendicular incidence on numerous metals and alloys for wave-lengths ranging from 250 to 1,500 $\mu\mu$, the general conclusion is that the reflectivity increases with the wave-length. Work on glass mirrors shows that the reflection will gradually fall off with age, although there may be no perceptible tarnish on the polished surface. A special arrangement was attached to a photometric optical bench to admit of the mirror under comparison and its illuminant (a Hefner lamp) to be turned together through any determined angle. Measurements of the light intensities were made with a Lummer-Brodhun photometer, arranged for equality of contrast. Tables and curves are given showing the results obtained at varying incidences with different types of plain glass and silvered surfaces. The initial superiority of silver before glass is about 6 per cent., but when the time factor is considered the silver behind glass is much more permanent in reflecting power. Thus a silver-fronted mirror after three months' exposure had fallen to 68 per cent., whereas an ordinary commercial back-silvered mirror at least three years old was still capable of reflecting 86·7 per cent. of the incident light. C. P. B.

1373. *Simple Means of Demonstrating the Existence of Temporary Double Refraction in Liquids.* **V. A. Bernatzky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. (Physical Part), pp. 39–43, 1905. From the Phys. Lab. of the Polytechnic Inst., Warsaw.)—The author points out that a liquid in flowing through a capillary tube is in the same condition as when between the two concentric cylinders in Maxwell's classical experiment. The temporary double refraction of liquids may therefore be demonstrated as follows. A tube of rectangular cross-section is formed by making a 1-mm. wide slit in a brass plate of 5 mm. thickness, and placing glass plates at the back and front of the slit; the tube thus formed is placed between crossed nicols and a current of olive oil, flowing from a reservoir under a pressure of 1½ to

3 atmospheres, is allowed to pass through it, while an image of it is thrown on the screen. A luminous image of the slit, crossed by a dark band in the middle, appears, but at once disappears on stopping the flow of the liquid.
D. H. J.

1374. *Indices of Refraction of Absorbing Liquids in the Ultra-violet.* **W. Fricke.** (Ann. d. Physik, 16. 5. pp. 865–889, May 16, 1905. Phys. Inst., Jena, March, 1904.)—The method employed was to photograph the interference fringes produced by a beam of rays of known wave-lengths, reflected from a film of the liquid in question. The source of light was a powerful spark between electrodes of certain metals, and a parallel beam of the light was directed down upon a horizontal film of the liquid; the reflected beam passed into an ordinary spectrograph, and the indices of refraction were calculated from measurements of the fringes upon the photographs. The results for several substances are given; they lie between the limits $\lambda = 5086$ and $\lambda = 2312{\cdot}9$.
E. C. C. B.

1375. *Telegraphy by Light Waves.* **V. J. Laine.** (Phys. Zeitschr. 6. pp. 282–283, May 1, 1905.)—The author proposes a system of telegraphy, or rather heliography, with use of three coloured screens. Two of these screens are fitted to the sending apparatus, and the third is used by the receiving operator. The first two screens are identical in appearance by transmitted light, viz., yellow, but one absorbs all the rays beyond $\lambda = 5200$, the other all rays beyond $\lambda = 4700$. The third screen absorbs from $\lambda = 7000$ to $\lambda = 5200$, with the result that light transmitted through the first screen appears red when examined through the third, while light transmitted through the second screen appears white. The sending instrument may be made to flash through either of the first two screens, and thus messages may be sent which are unintelligible unless examined through the third screen.
E. C. C. B.

1376. *Electro-Optics of Metals.* **M. Reinganum.** (Ann. d. Physik, 16. 5. pp. 958–960, May 16, 1905. Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 820–821, May 11, 1905.)—Respecting the apparent disagreement between Maxwell's theory (as to connection between conductivity and reflections coefficient) and experimental results near the visible spectrum, the author enunciates the following statement: "If a periodic electric force acts, then the conductivity will no longer be of the normal value if the *period of the separate force-directions is comparable with the time between two impulses of the current-bearing electrons.*" A numerical illustration for copper is then worked out. (Ibid. 17. 1. p. 196.) Some corrections to the above paper are given.
E. H. B.

1377. *Radiation Pressure.* **J. H. Poynting.** (Phys. Soc., Proc. 19. pp. 475–490, April, 1905. Inaugural Address. Phil. Mag. 9. pp. 393–406, April, 1905.)—When the corpuscular theory held almost universal sway, it would have been much easier to account for the pressure of light than it is to-day, when all are certain that light is a form of wave-motion. Indeed, on the older theory it was so natural to expect a pressure that numerous attempts were made in the eighteenth century to detect it. But the early experimenters had a greatly exaggerated idea of the force they looked for. Even on their own theory it would only have double the value which we now know it to possess, and their methods of experiment were utterly inadequate to show so small a quantity. The first suggestion that the existence of pressure due to waves is a general property of waves seems due to S. T. Preston (1876). But to the present author Preston's reasoning seems inconclusive, and a general direct theorem is still awaited. In the meantime the simple indirect mode of proving the existence of pressure, due to J. Larmor, is very valuable. Let us suppose that a train of waves is incident normally on a perfectly reflecting surface. Then, whether the reflecting surface is at rest or is moving to or from the source, the perfect reflection requires that the disturbance at its surface shall be annulled by the superposition of the direct and reflected trains. They must, therefore, have equal amplitude. Suppose, now, that the reflector is moving forwards towards the source. By Doppler's principle, the waves of the reflected train are shortened, and so contain more energy than those of the incident train. This extra energy can only be accounted for by supposing that there is a pressure against the reflector, and that work has to be done in pushing it forward. When the velocity of the reflector is small, the pressure is easily found to be equal to $E\left\{1 + (2u/U)\right\}$, where E/2 is the energy density. Just outside the reflector in the incident train, U is the wave velocity, and $u$ that of the reflector. A similar train of reasoning gives us a pressure on the source. Special treatments for the pressure of electric waves, sound waves, and transverse waves in an elastic solid are then discussed. Theory and experiments justify the conclusion that when a source is pouring out waves, it is pouring out with them forward momentum as well as energy, the momentum being manifested in the reaction, the back pressure against the source, and in the forward pressure when the waves reach an opposing surface. The values of the total forces operative for total reflection, absorption, and refraction are then shown graphically by vector diagrams. The paper concludes with astronomical applications and the possibilities of the Radiation theory. [See also Abstracts Nos. 1495 (1902) and 339 and 716 (1905).] E. H. B.

**1378.** *Elimination of Gas Action in Experiments on Light-Pressure.* **G. F. Hull.** (Phys. Rev. 20. pp. 292–299, May, 1905.)—That a beam of light falling on a vane suspended in a partial vacuum produces pressure has been established experimentally by Lebedew and by Nichols and Hull [see Abstracts Nos. 1059 (1901) and 60 (1904)]. The essential point in demonstrating the pressure due to radiation is the elimination of the "gas action" on the vane. Lebedew attempted to do this by using very thin vanes and high vacua. The exact value of this vacuum is not stated by Lebedew, but it was probably of the order of 0·00001 mm. Even with a vacuum so difficult to maintain as this, the deflection of his torsion system differed from that due to light-pressure by 80 per cent. of the latter. The arrangement and methods of Nichols and Hull were briefly as follows: (1) The vane was silvered. Thus the radiation pressure was twice as great, and the gas action about one-tenth as great, as the corresponding effects for a black surface. (2) The pressure of air in the receiver was varied until the gas action was a minimum. (3) Throws were taken with the silvered side of the vane towards and away from the light, the argument being that the gas action upon the warmer (the silvered) side of the vane would thus be in opposite directions in the two cases, while the light pressure would be unchanged in sign. The results show that, using silvered surfaces, the mean deflection from a large number of observations did not differ from that due to light pressure by more than 1 per cent. of the latter. Still, however, the gas action was somewhat erratic and called for examination. A number of experiments are now described which aim at the elimination of this gas action. They show that this can be to a great extent accomplished by enclosing the absorbing or reflecting surface and making it vertical. The obvious characteristic of light pressure in contrast to gas action, viz., the greater pressure on the reflecting surface, may easily be shown by this arrangement. E. H. B.

1379. *Theory of Experiments to Detect Aberrations of the Second Degree.* **E. W. Morley** and **D. C. Miller.** (Phil. Mag. 9. pp. 669–680, May, 1905. Paper read before the National Academy of Sciences.)—In 1887 Michelson and Morley, in their experiment "On the Relative Motion of the Earth and the Luminiferous Æther," found that the effect, if any, was of the order one-fortieth of the amount expected. To explain this result, Fitzgerald and Lorentz suggested that the motion of translation of a solid through the ether produces a contraction in the direction of the drift, with extension transversely, the amount of which is proportional to the square of the ratio of speeds of translation and of light. Such a contraction can be imagined in two ways. It may be supposed independent of the physical properties of the solid, and governed only by geometric conditions; so that sandstone and pine, if of the same form, should be affected in the same ratio. Or the contraction might depend upon the physical properties of the solid; so that pine and timber would doubtless suffer a greater compression than sandstone. If the compression annul the expected effect in one apparatus, it might in another apparatus give place to an effect other than zero, perhaps with the contrary sign. An experiment has been completed in which two different pine structures have been used, and in which the optical parts have been so enlarged as to produce an effect 2·8 times as great as that of the 1887 apparatus. The object was to determine whether there is any difference between the behaviour of sandstone and of pine. When Michelson and Morley obtained a null result in 1887, it was thought sufficient to give the theory for merely the maximum and the minimum expected in the four principal azimuths, without mention of the phenomena at intermediate azimuths. The theory also neglected powers higher than the second of the ratio of speeds. Recently Hicks has published an elaborate discussion of the theory, obtained by methods which are not approximate. [See Abstract No. 1055 (1902).] In one passage of this discussion it is stated that a term which it introduces might "entirely modify the nature of the changes produced as the direction of the drift alters." From this passage some seem to have imagined that the inference from the earlier experiment is now involved in doubt. Hence the re-examination of the theory in the present paper, which arrives at the following conclusions: The authors maintain (1) that the theory of 1887 is correct to terms of the order retained, which were sufficient; (2) that Hicks' theory agrees with it precisely as to numerical amount and sign of the effect; and (3) that a further examination of the theory gives results differing from those of the other two only by negligible terms of the third order. E. H. B.

1380. *Anomalous Dispersion of the Magnetic Rotation of the Plane of Polarisation.* **R. W. Wood.** (Phil. Mag. 9. pp. 725–727, May, 1905. Phys. Zeitschr. 6. pp. 416–417, July 1, 1905.)—The form of the curve representing the magnetic rotatory dispersion of absorbing media in the vicinity of the absorption band is of some importance because the hypothesis of molecular currents demands anomalous dispersion, while on the other hand the Hall-effect hypothesis calls for rotations of similar sign on the opposite sides of the band. Schmauss has published some investigations which support the first theory; while Bates, using a more accurate method, found only negative results, *i.e.*, the dye had no influence upon the magnetic rotatory power of the solvent. The author found similar negative results with a film of solid cyanine. Recently, however, the author has experimented with a saturated solution of praseodymium chloride, and has found undoubted evidence of anomalous dispersion. Strong elliptical polarisation was observed in the vicinity of the absorption band, which made accurate readings difficult, but the evidence of a great number of readings is undoubtedly in favour of the existence of anomalous rotatory dispersion. E. C. C. B.

**1381.** *Intensity of Grating Spectra.* **R. W. Wood.** (Astrophys. Journ. 21. pp. 173–175, March, 1905. Phys. Zeitschr. 6. pp. 238–239, April 15, 1905.)—An apparatus for the photometric comparison of grating spectra is described in detail. The measuring apparatus proper consists essentially of a pair of nicol prisms (one mounted in a graduated circle), a small piece of silvered glass, and a bright, uniform sodium flame. The silvered glass is mounted vertically at 48° with the axes of the nicols, and is arranged to cover the lower half of the field. The sodium flame being immediately behind the polariser, and the grating to one side, the intensity of the spectrum selected can be directly compared with the constant sodium flame, and by rotation of the nicol analyser a definite comparison can be obtained. Assuming speculum metal reflects about 70 per cent. of the incident light, it was found that about 35 per cent. of the total was diffracted in the first order. C. P. B.

**1382.** *Effect of Capacity and Self-induction on Spark-spectrum Wave-lengths.* **G. W. Middlekauff.** (Astrophys. Journ. 21. pp. 116–123, March, 1905.)—As the spark spectrum is usually employed as comparison for determinations of stellar velocities in the line of sight, it is of great importance to know whether the wave-lengths of the spark lines are constant or otherwise. The author reviews previous work of Exner, Haschek, Mohler, Mache, Eder, and Valenta, in the course of which results were obtained giving somewhat discordant conclusions. With the hope of obtaining evidence on this, photographs were obtained with a 21½-ft. concave grating having 20,000 lines to the inch, the spark being obtained from a 50-volt alternating-current of about 25 amps. at about 133 cycles per sec. After being stepped up to about 600 volts, it was transformed up sufficiently to produce a spark about 2 cm. in length. Poles of Norway iron about 8 mm. diam. without auxiliary spark gap were used. The arc spectra for comparison were from a 110-volt direct current of about 10 amps. The capacity consisted of sheets of copper-foil and glass, and could be varied from 0·0085 to 0·0739 m.f.d. The self-induction apparatus consisted of 3 coils of No. 10 copper wire, the amount of induction introduced varying from 0·00007 to 0·0012 henry. The usual precautions were taken to eliminate instrumental shift of the lines, by means of suitably-arranged shutters. From many repeated experiments the author concludes that, so far as the accuracy of measurement permitted, no shift ever occurred when the self-induction was thrown into circuit. Also, within the limits before stated, no sensible change in the position of the spark lines was caused by changes in the capacity of the circuit. A further important statement is that there is no appreciable difference between the wave-lengths of the same lines as observed in the spark and arc spectra. [See also Abstract No. 2536 (1904).] C. P. B.

1383. *Arc Spectrum of Scandium.* **N. Lockyer** and **F. E. Baxandall.** (Roy. Soc., Proc. 74. pp. 538–545, April 10, 1905.)—Scandium has of late years been found to be a very important constituent of many celestial bodies, and it is therefore necessary to have a complete record of its spectrum under terrestrial conditions. Photographs of the spectrum of a sample of scandium oxalate were obtained with a large concave grating by C. P. Butler, and the wave-lengths deduced from measures of these plates are tabulated, comparisons being given with the published values of Exner and Haschek, and of the corresponding solar lines for lines established to be identical. Scandium plays a most important part in the elucidation of the chromospheric spectrum, and a special list of these lines is given; the prevalence of scandium lines as among those most affected in sun-spot spectra is also emphasised. In stellar spectra scandium is found to vary with the type of spectrum; certainly present in stars like $\gamma$ Cygni, where the lines are similar to those found in the solar chromospheric spectrum, the spectrum of the next higher stage, like $\alpha$ Cygni, only contains the strongest scandium line at 4247·0, and at higher levels still, $\beta$ Orionis, $\zeta$ Tauri, $\gamma$ Orionis, $\zeta$ Orionis, the element has so far not been detected. C. P. B.

1384. *New Method of Interferential Spectroscopy.* **C. Fabry.** (Comptes Rendus, 140. pp. 848–851, March 27, 1905.)—The former apparatus used for interferential spectrum analyses [see Abstract No. 1000 (1904)] presents some difficulties when it is necessary to examine the spectrum of a source giving numerous fine lines, each of which must be separated; it is also difficult to set on any required line out of the visible spectrum, say, in the ultra-violet. In the method now proposed these difficulties are overcome. The source of light is placed at the focus of a lens of about 10 cm. focal length, and the emergent rays pass through the silvered plates of the interferometer, rendered rigorously parallel to each other. A second lens placed near the plates gives an image at its focal plane, of the series of rings produced by the plates. At this focus is adjusted the slit of a spectroscope which is anastigmatic. The rings will then be observed as a series of points distributed throughout the spectrum, which may be recognised without difficulty. In a single exposure a photograph of the whole series may be obtained, and the light available is much better utilised. C. P. B.

1385. *Spectra from the Wehnelt Interrupter. II.* **H. W. Morse.** (Astrophys. Journ. 21. pp. 223–235, April, 1905.)—A continuation of the investigation into the spectra of various metals in an arrangement similar to the Wehnelt interrupter [see Abstract No. 1349 (1904)]. Detailed results are given, from which it is concluded that no definite type of spectrum can be said to be characteristic of this method of spectrum production, although certain well-marked differences are observed from the arc and spark spectra. The variations in intensity in passing from spark to Wehnelt are closely parallel to the variations introduced in the spark by self-induction. Series lines appear to suffer little change with the varied conditions, but the non-series lines show in many cases great variations in intensity. The bands observed in the Wehnelt spectrum have been seen under other experimental conditions, *e.g.*, O-H flame spectrum and the arc in an atmosphere of hydrogen. These bands were best observed in the case of Zn, Cd, Sn, and Au. E. C. C. B.

1386. *Wave-lengths of Red Lines in Arc Spectra.* **H. Hermann.** (Ann. d. Physik, 16. 4. pp. 684–707, April 11, 1905. Extract from Tübingen Inaug.

Dissertation, 1904.)—This paper contains an account of an investigation with the object of obtaining more accurate measurements of a number of lines in the red portion of various arc spectra of metals. The paper includes a discussion of the arrangement of a concave grating according to Runge and Paschen's method with measurement of the aberration; a modification of Burbank's method for the rendering sensitive of photographic plates for the red and ultra-red; more accurate measurements of the hitherto least accurately known lines in the arc spectra of Na, K, Mg, Ca, Ba, Hg, between the wave-lengths 6,000 and 9,200; comparison with Abney's solar spectrum; a discussion of Ritz's formula [see Abstract No. 72 (1904)] for the first group series of Cd, Zn, Hg, and an investigation on the lines $m = 2$ of this formula, as well as the corresponding lines of other series spectra. The Rowland concave grating used had a radius of curvature of 3 m., and was free from the usual "ghosts," but showed the series of false lines described by Lyman. The position and appearance of these Lyman's "ghosts" is described in certain cases. To each strong real line corresponded a whole series of false ones. J. J. S.

1387. *Infra-red Absorption Spectrum of Carbon Dioxide.* **H. Rubens** and **E. Ladenburg.** (Deutsch. Phys. Gesell., Verh. 7. 7. pp. 170–182, April 15, 1905. Phys. Inst. der techn. Hochschule, Charlottenburg, March, 1905.)—An investigation into the absorption by $CO_2$ of the rays of long wave-length in order to test the probabiltiy of Arrhenius' suggestion that the glacial epoch was due to a decrease in the atmospherical content of this gas (Phil. Mag. 41. p. 237, 1896). Measurements were made with different layers of $CO_2$ with a Welsbach burner as source and a thermopile as receiver. Some measurements were made of the radiation from the thermopile to a black body at $-80°$ C. It was found that the ordinary law of absorption is not obeyed, but that the amount of absorption is proportional to the logarithm of the thickness of the layer of $CO_2$. Further, the authors calculated the probable value of the absorption by the $CO_2$ in the air, and found that the occurrence of the glacial epoch cannot be accounted for by the supposed disappearance of all of this gas from the atmosphere. E. C. C. B.

1388. *Sensitive Method for the Spectroscopic Analysis of Mixtures of Gases.* **J. E. Lilienfeld.** (Ann. d. Physik, 16. 5. pp. 931–942, May 16, 1905. Phys. Inst. der Univ., Berlin, March 4, 1905.)—The author finds that if self-induction as well as capacity be introduced into the secondary circuit of an induction coil, it is possible in the spectrum of the discharge to detect the lines of extremely small quantities of a gas in a mixture. This is especially true if the self-induction spool be placed parallel and close to the capillary portion of the vacuum tube. He was able to detect 0·7 per cent. of helium and 0·9 per cent. of argon in mixtures of these gases with nitrogen, and 0·7 per cent. of hydrogen or nitrogen in mixtures of these gases with mercury vapour. Hitherto it has only been considered possible to detect quantities of from 10–30 per cent. E. C. C. B.

1389. *Luminescence of Crystals.* **A. Pochettino.** (Accad. Lincei, Atti, 14. pp. 505–512, May 7, 1905.)—The author has examined qualitatively the luminesence produced in certain crystals by exposure to radium or Röntgen rays, or, in some cases, violet light. The following crystalline bodies give a luminescence of the same colour with both radium and Röntgen rays: Magnesium platinocyanide—orange-greenish, slightly polarised; calcium platinocyanide—bright green, polarised if excited by radium, but not if caused by Röntgen rays; platinocyanide of sodium and potassium—slightly yellowish, polarised; barium platinocyanide—green, polarised; scheelite—blue, little if at all polarised. Neither radium nor Röntgen rays excite fluorescence in erbium or yttrium platinocyanides, though violet rays cause a reddish-scarlet luminescence. Phosgenite gives no luminescence with Röntgen rays, but a faint blue (non-polarised) with radium. Apatite gives no luminescence with Röntgen rays, but a weak yellowish-green, slightly polarised fluorescence after exposure to radium rays. D. H. J.

1390. *Photographic Radiation of some Mercury Compounds.* **R. de J. F. Struthers** and **J. E. Marsh.** (Chem. Soc., Journ. 87. pp. 377–380, April, 1905.)—By combining mercuric cyanide with phenylhydrazine, a compound $HgC_2N_2, 2(NH_2{\cdot}NH{\cdot}C_6H_5)$ is obtained which acts on a photographic plate, even through a sheet of paper, in a few hours, a dark patch appearing, on development, under where the substance has rested. The action also takes place through a thin layer of aluminium foil, and a just perceptible darkening was once obtained through a disc of quartz. No electrical activity of the substance could be detected, and only 0·14 per cent. is lost in weight after exposure for four weeks in a desiccator over sulphuric acid. An examination of mercuric cyanide and phenylhydrazine separately shows that, while the action of the latter is more sluggish and diffused than that of the compound, mercuric cyanide behaves less definitely, some specimens being active, others inactive; the active salts lose their activity after heating. Inactive cyanide is rendered active by slightly moistening with water, but if covered with water it is inactive. Mercuric cyanide, prepared from inactive mercuric oxide and hydrocyanic acid, is active, as are also mercuric chloride and bromide, and mercuric and mercurous nitrate. Mercuric iodide, sulphate, acetate, sulphide, and oxide, mercuric ammonium chloride, and mercurous chloride, sulphate, acetate, and oxide, are inactive, or, at the most, only very slightly active. Re-distilled metallic mercury has no action on a gelatine dry-plate, and cuprous and silver cyanides are also inactive. W. H. St.

1391. *Penetrating Radiation.* **C. Barus.** (Science, 21. pp. 561–566, April 14, 1905.)—Nuclei were produced under the action of a Röntgen bulb. A very penetrating radiation appeared to be present. For very short exposures the nucleation is the same whether the bulb is placed at 6 cm. or 600 cm. from the fog-chamber. The radiation was not stopped by lead screens several cm. in thickness placed between bulb and fog-chamber. J. J. S.

1392. *Decay of Excited Radio-activity from Natural Gases.* **Miss L. B. Johnson.** (Phys. Rev. 20. pp. 177–182, March, 1905. Abstract of paper read before the Amer. Physical Soc., Dec. 30, 1904.)—As soon as the gas is received from the well, a rod is exposed in it which is charged negatively. This is rendered active; after its removal the gas rises in conductivity to a maximum value, and then falls according to an exponential law. In order to investigate how the excited activity varies with the time of exposure, a series of rods are placed in the testing vessel for different times. For all periods the radiation decreases initially, then reaches a steady state which lengthens as the time of exposure decreases, after which it drops steadily. It is concluded that the emanation found in natural gases has radium for its source. R. S. W.

**1393.** *Secondary Radiation Produced from Different Metals by γ-Rays.* **H. F. Dawes.** (Phys. Rev. 20. pp. 182–185, March, 1905. Abstract of paper read before the Amer. Physical Soc., Dec. 30, 1904. Röntgen Soc., Journ. 1, pp. 93–94, April, 1905.)—After passing through about 15 mm. of lead, the rays pass in succession through about a dozen plates, each of different metal and about 5 mm. thick, as this is thought sufficient to cut off the secondary rays coming through a plate from the one below it. The secondary rays produced at the upper surface of the last plate can be bent by a magnet into or away from an electroscope. By interchanging the top plate the different metals may be tested. It appears that the secondary radiation is not even approximately proportional to the density of the radiating substance. R. S. W.

**1394.** *Emanium.* **F. Giesel.** (Ber. Deut. Chem. Gesell. 38. pp. 775–778, Feb. 25, 1905. Chem. News, 91. p. 145, March 31, 1905.)—Investigations of the origin of the three lines of self-luminous lanthanum chloride containing emanium have shown that these lines do not belong to emanium but to didymium. A commercial lanthanum chloride when dehydrated and exposed to the radiation of 0·4 gm. of radium bromide became luminescent, and showed in the spectroscope two lines whose position pointed to their identity with the lines discovered in the emanium preparation. Pure lanthanum chloride gave a continuous spectrum without any indication of lines. The chemical methods for concentrating the emanium are described. The active substances separated by ammonium from emanium are best denoted as emanium X or "EX." New formations take place in emanium preparations, as in the case of thorium, and the activity of emanium is to be ascribed essentially to EX. In the small ammonium chloride residue separated, is found, as in Rutherford's ThX, almost all the activity of the emanation preparation. The greater part of the EX can be separated from the burnt oxides by means of a little dilute nitric acid, so that not all the rare earths need be precipitated with ammonia. Precipitation of EX is also brought about by precipitation with barium sulphate, but it is not complete. T. M. L.

**1395.** *Radio-activity of the Bohemian Thermal Springs.* **H. Mache** and **S. Meyer.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 355–385, March and April, 1905. From the II. Phys. Inst. and the Inst. f. theoret. Physik. an der k.k. Univ. in Wien.)—Using the same method as was previously employed by Mache [see Abstract No. 989 (1905)], the authors have investigated the comparative amounts of emanation yielded by the springs at Carlsbad, Marienbad, Teplitz-Schönau-Dux, Franzensbad, and St. Joachimsthal. The results are very variable, and are given in tabular form. The St. Joachimsthal water showed the largest amount ever found in any spring-water ($i \times 10^3 = 185$ electrostatic units), even including Gastein. The rate of decay of the emanation and of the induced activity from the waters and sediments, curves for which are given, is practically identical with that of radium. No thorium was present. L. H. W.

**1396.** *Excited Activity of Thorium.* **Miss J. M. W. Slater.** (Phil. Mag. 9. pp. 628–644, May, 1905.)—The paper consists of two parts, giving the results of an investigation into the effects on thorium-excited activity of (1) kathode rays, (2) heat. Two plates, A and B, are made active, and then A is exposed to the action of the kathode rays. A decrease in activity relative to B is always brought about, even when the active matter is on one face and the other is exposed to the rays. It is shown that this is not effected by low pressure alone, strong local heating due to the rays, ultra-violet light, chemical action of the gases in the tube, action of free ions formed during the discharge, or soft Röntgen rays. It is concluded that the direct action of the rays is the cause. The activity which disappears from A is found on the walls of the tube, and its rate of decay for several hours is always greater than the normal value, while that remaining on A at first decays more slowly than the comparison disc B. The disc A is placed in a metal box and again exposed to the rays; after exposure the activity of A is found to be diminished, but then gradually rises, reaches a maximum, and decreases according to the usual law. This shows that the rays have separated the active deposit into its two components, thorium A and B. A gives out no rays on changing into B; B emits rays. Contrary to the earlier views of Rutherford, it is the second change which is the more rapid. The fall in the activity immediately after exposure gives the fraction of thorium B driven off; after several hours the activity of plate A is proportional to the amount of the more slowly decaying thorium A, and therefore the activity of this plate as compared with B gives the amount of thorium A driven off by the kathode rays. This separation of thorium A and B can be brought about by heat; thorium A commences to volatilise at 640°, thorium B at 730°. This gives a means of obtaining the products nearly wholly separate one from the other. R. S. W.

1397. *Secondary Radiation and Atomic Structure.* **J. A. McClelland.** (Roy. Dublin Soc., Trans. 9. 1. pp. 1–8, May 17, 1905.) This paper is a continuation of a previous one [see Abstract No. 992 (1905)].—The result formerly reached, that the secondary radiation is always greater, the greater the atomic weight of the radiating substance, has been fully confirmed. From a table drawn up from the observations made, it appears clearly as stated in the author's previous paper, that as the atomic weight increases the secondary radiation increases, but less rapidly. The elements fall into well-defined divisions in a striking manner if a curve is plotted with atomic weight as abscissa and secondary radiation as ordinate. This division corresponds to the division of the elements into "periods" employed in chemistry. The elements contained in each chemical period lie on a part of the curve which is practically a straight line. Going from one period to the next, there is very little increase of secondary radiation, so that there is a marked change in the slope of the curve at these parts. The flattening begins at or near the top of each period, and in the next period a more rapid increase of secondary radiation again sets in. To explain the results it is noted that the incident primary radiation consists chiefly of $\beta$-particles, each of which is small compared with the atom as a whole, so that each primary $\beta$-particle may be regarded as colliding with an electron (or $\beta$-particle) of the atom of the substance being tested for secondary radiation, rather than with the atom as a whole. If all atoms are composed of electrons, for a given incident primary radiation the same number of electrons will be disturbed in the substance tested, whatever that substance is. The greater the atomic weight of the substance, the greater, therefore, is the disturbance produced in any one atom, and the greater the chance of detaching electrons to produce the secondary radiation. Moreover, the falling into different groups of the elements, as shown on the curve connecting atomic weight and secondary radiation, leads to the view that the manner in which additional electrons are added on to form elements of greater atomic weight is different on passing from one period to the next, from what it is on passing through elements not near the ends of a period. This agrees with the views as to the constitution of the atom advanced recently by J. J. Thomson, who deduces from theoretical investigations on stability, that, as the number of electrons in the atoms are increased, they may take up a position on an outer shell, or they may go to form a central core, thus giving in general two different ways of adding on the additional electrons. J. J. S.

1398. *New Radio-active Element which Evolves Thorium Emanation.* **O. Hahn.** (Roy. Soc., Proc. Ser. A. 76. pp. 115–117, May 24, 1905. Zeitschr. Phys. Chem. 51. pp. 717–720, May 9, 1905.)—The material for the investigation consists of the final residue remaining after fusion with bisulphate, of 5 cwt. of thorianite from Ceylon. This is fused with carbonates, the silica removed, and the carbonates dissolved in HCl. Lead is precipitated as sulphide and the carbonates again precipitated. This residue weighs about 18 gm., and a preliminary estimation of its radio-activity shows that it ought to yield 15 mgm. of radium bromide. On following Giesel's method of obtaining the bromide by fractionation, the radium concentrates at the least soluble end, the middle fractions become relatively weak in activity, and the more soluble portions become increasingly more radio-active. Small traces of iron are found in the last, and on treatment with $H_2S$, a minute quantity of a dark brown precipitate comes down, which is radio-active. It is soluble in $HNO_3$, and when evaporated yields soluble green crystals and less soluble white ones. These are being investigated. By a series of operations a quantity of precipitate is obtained with ammonia, which, when freed from iron, weighs 10 mgm. It is very active, and after two months shows no diminution of activity. It glows feebly in the dark, and gives off an emanation which appears to be identical with that of thorium. The induced activity falls to half value in 11½ hours, and a small remainder persists which decays very slowly. It is certain that neither radium E nor radium emanation is present. The 10 mgm. dissolved in HCl gives a quantity of emanation greater than would be evolved by 1 kg. of thorium in solution. Thorium cannot with certainty be detected. After precipitation by ammonia the filtrate shows considerable radio-activity, which rapidly falls off for a few days, but does not wholly disappear. The removal of this substance does not diminish appreciably the activity of the insoluble residue. Whether that is due to ThX has not yet been determined. R. S. W.

1399. *Action of Radio-active Bodies on Gelatin Media.* **J. B. Burke.** (Nature, 72. pp. 78–79, May 25, 1905.)—A note on the production of a peculiar culture-like growth which appeared in gelatin media, such as those generally used for bacterial cultures, when radium chloride or radium bromide was allowed to drop upon the surface of the gelatin. The minute structures thus arising in a carefully-sterilised medium, while not bacteria, yet go through a process of growth and segregation, and appear to be highly organised bodies. Their behaviour differs from that of an aggregate of crystals. J. J. S.

1400. *Polarised Röntgen Radiation.* **C. G. Barkla.** (Roy. Soc., Phil. Trans. 204. pp. 467–479, May 31, 1905. Roy. Soc., Proc. 74. pp. 474–475, March 16, 1905. Abstract.)—In a previous paper [see Abstract No. 1650 (1904)] it was shown that the character of this radiation differs only very slightly from that of the radiation producing it, and that the energy of this radiation is proportional to the quantity of matter through which a beam of

Röntgen radiation of definite intensity passes, being independent of the kind of matter. These results, and the agreement between the energy experimentally determined and that calculated, led to the conclusion that this radiation is due to what may be called a scattering of primary Röntgen rays by the corpuscles or electrons constituting the molecules of the substance. On the hypothesis that Röntgen rays consist of a succession of electromagnetic pulses in the ether, each electron in the medium through which these pulses pass has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the electron, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the electron. On this theory, a secondary beam whose direction of propagation is perpendicular to that of the primary, will be plane polarised, the direction of electric intensity being parallel to the pulse front in the primary beam. If the primary beam be plane polarised, the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement. The secondary radiation from light substances was too feeble to allow accurate measurement of the intensity of the tertiary radiation. Consideration of the method of production of primary rays in a Röntgen-ray tube leads to the expectation that in a beam of Röntgen rays proceeding in a direction perpendicular to that of the kathode stream, there should be greater electric intensity parallel to the stream than in a direction at right angles. Such a beam was, therefore, used as the primary radiation, and the intensity of secondary radiation proceeding in a direction perpendicular to that of propagation of the primary beam from a radiator placed in that beam, was studied by means of electroscopes. In the final form of apparatus the intensity of secondary radiation was measured in two directions, perpendicular to that of propagation of the primary radiation and to each other, while the intensity of the primary beam was measured by a third electroscope. Using paper, aluminium, or air as the radiator, as the bulb was turned round the axis of the primary beam studied, the intensity of a secondary beam was found to reach a maximum when the direction of the kathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel, one electroscope recording a maximum rate of deflection when the other recorded a minimum. Many experiments were made, the evidence of partial polarisation appearing conclusive. When heavier metals, such as copper, tin, and lead, which emit a secondary radiation differing considerably in character from the primary producing it, were used as radiators, no variation in intensity of secondary radiation was observed as the bulb was rotated. This result was not found to be affected by a considerable variation in the penetrating power of the primary radiation. Experiments were made with several Röntgen-ray tubes. (Nature, 71. p. 440, March 9, 1905.) Later experiments have shown that beams of Röntgen radiation can be produced exhibiting greater polarisation than there was evidence of in the original experiments. J. J. S.

**1401.** *Radium Emanation.* **R. Hofmann.** (Phys. Zeitschr. 6. pp. 337–340, June 1, 1905. II. Phys. Inst., Wien, April, 1905.)—This paper treats first of the absorption coefficients of different liquids for radium emanation, and concludes with a method of determining the emanating properties of air. A brief review of the work of v. Traubenberg and Mache is given [see Abstracts Nos. 866 and 989 (1905)]. Using a slight modification of Elster and Geitel's method, a mean value for the absorption coefficient ($\alpha$) of water at summer temperature (20° C.) was obtained, the value being 0·23, which differs from the values found by Traubenberg and Mache. The variation of $\alpha$ with temperature for water and petroleum is given in the following table:—

| Temperature. | $\alpha$ (Water). | $\alpha$ (Petroleum). |
|---|---|---|
| −21° C. | — | 22·70 |
| 3 | 0·245 | 12·87 |
| 20 | 0·23 | 9·55 |
| 40 | 0·17 | 8·13 |
| 60 | 0·135 | 7·01 |
| 70 | 0·12 | — |
| 80 | 0·12 | — |

which shows that for water the value of $\alpha$ decreases almost uniformly with increase of temperature, while for petroleum the decrease is much greater between −21° and 10° than between 10° and 60°. A. W.

## REFERENCES.

1402. *Simplified Mounting for Spectrograph Gratings.* **C. Leiss.** (Zeitschr. Instrumentenk. 25. pp. 96–98, April, 1905. Communication from R. Fuess's Workshops.)—A short description, with illustrations, of new and less expensive stands for mounting the slit, grating, and camera for spectrographic work with the larger Rowland gratings. The dark slide is made for a plate or film of size 4 × 30 cm. bent into circular shape. G. E. A.

1403. *Distortion produced by Focal Plane Shutters.* **E. Bose.** (Phys. Zeitschr. 6. pp. 151–153, March 1, 1905.)—A short discussion of the distortion found in photographs taken with slit shutters when the speed of the object becomes nearly of the same order as that of the shutter. Examples are given illustrating the effect produced. C. P. B.

1404. *Transparence of Copper to Visible and Infra-red Rays.* **J. Javal.** (Annal. Chim. Phys. 5. pp. 137–144, May, 1905.)—The films of copper employed were formed by kathodic deposition, their thickness being measured by Houllevigue's method [see Abstract No. 468 (1903)]. The experimental procedure was similar to that of Hagen and Rubens [Abstract No. 1049 (1902)]. The curve given shows a minimum absorption at $\lambda = 535\mu\mu$. G. E. A.

1405. *Optical Determination of the Zero Point in the Telescope-Mirror-Scale Method.* **A. de Forest Palmer, Jr.** (Phys. Rev. 20. pp. 333–336, May, 1905.)—A description of this adjustment by means of a mirror mounted on a brass plate with three levelling screws. G. E. A.

1406. *Curvature of Interference Bands from Echelon Gratings.* **M. Laue.** (Phys. Zeitschr. 6. pp. 283–285, May 1, 1905.)—A mathematical paper explaining why and to what extent the interference bands observed or photographed from echelon gratings are curved. E. H. B.

1407. *Identity of the Cause of White and Black Silhouette in Photographic Development.* **A. Guébhard.** (Comptes Rendus, 140. pp. 1334–1337, May 15, 1905.)—This identity is established by reference to the general form of some curves of photographic development given in a previous paper. [See Abstract No. 1060 (1904).] G. E. A.

1408. *Effect of Electric Vibrations on Optically-active Bodies.* **W. Voigt.** (Gesell. Wiss. Göttingen, Nachr., Math.-Phys. Klasse, 5. pp. 467–479, Dec., 1904.)—This paper elaborates a mathematical theory which it is proposed to test experimentally. An arrangement for this purpose is described, with which preliminary observations have been made, but it is hoped shortly to instal a more regular interrupter and a detector of more trustworthy quantitative action. [See also Abstract No. 528 (1904).] E. H. B.

1409. *Radiation and Electromagnetic Theory.* II. *Æolotropic Potential.* **R. Hargreaves.** (Phil. Mag. 9. pp. 425–466, April, 1905.)—This is the second part of the paper whose first part was dealt with in Abstract No. 976 (1905). It is highly analytical and unsuitable for detailed abstraction. It deals with (1) the equations of Laplace and Poisson in general æolotropic form for an ellipsoid, (2) a theorem akin to Maclaurin's, (3) the derivation of momentum, (4) solution for density a linear function of co-ordinates, (5) case where translation exceeds speed of light, (6) general validity of new form of solution for isotropic or æolotropic potential. E. H. B.

1410. *Influence of Electrical Force in Foggy Atmosphere on Refraction.* **J. Kiessling** and **E. Barkow.** (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 11–13, Jan. 30, 1905.)—Short note on experiments at Marburg Physical Institute. C. P. B.

1411. *An Artificial Chromosphere.* **E. Pringsheim.** (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 14–15, Jan. 30, 1905.)—Simple experimental illustration of producing spectrum phenomena similar to those observed in the solar chromosphere. C. P. B.

1412. *Ultra-red Absorption Spectrum of Ozone.* **K. Ångström.** (Ark. för Mat. Astron. och Fysik, Stockholm, 1. pp. 347–353, 1904.)—This paper only gives short notes on the investigation. The spectrum was examined from λλ7,000—16,000, and several absorption bands found. C. P. B.

1413. *Ozone Bands in Solar Spectrum.* **K. Ångström.** (Ark. för Mat. Astron. och Fysik, Stockholm, 1. pp. 395–400, 1904.)—Notes on experiments for comparison of bands in solar spectrum with spectrum of ozone under varying intensities of current. C. P. B.

1414. *Magnetic Rotation of Plane of Polarisation near an Absorption Band.* **J. J. Hallo.** (Archives Néerlandaises, 10. pp. 148–205, 1905. Abridged Translation of Dissertation, Amsterdam, 1902.)—Describes elaborate experiments in confirmation of the theories of Lorentz and Voigt. An arc lamp was used as the source of light, and a Rowland grating to obtain the spectrum, the absorption bands being due to sodium vapour. [See also Abstract No. 801 (1903).] E. H. B.

1415. *Ultra-violet Absorption Bands of Blood and its Derivatives.* **R. Hiller.** (Beibl. Ann. d. Physik, 28. 17. pp. 919–920, 1904. Extract from the Rostock Dissertation, 1904.)—A zinc-cadmium spark was used as light source, and also a quartz spectrograph, by means of which photographs of the spectrum of the spark were obtained after the light had passed through the various solutions contained in a quartz cell. Details of the limits of the absorption bands are given. E. C. C. B.

1416. *Construction for Luminous Rays entering an Opaque Medium.* **J. Boussinesq.** (Comptes Rendus, 140. pp. 825–830, March 27, 1905.)—Mathematical treatment for such rays entering a plane face of a homogeneous opaque medium. J. W. P.

1417. *Narrow Triplets in Spectra of Calcium and Strontium.* **F. A. Saunders.** (Astrophys. Journ. 21. pp. 195–196, March, 1905.)—During the reduction of a series of grating photographs, new series in the spectra of calcium and strontium were found, of similar character to those previously found by Fowler in strontium. A formula is given satisfying the wave-lengths of the first lines of the triplets. [See also Abstract No. 979 (1905).] C. P. B.

1418. *Infra-red Absorption Spectra.* I. *Gases.* **W. W. Coblentz.** (Phys. Rev. 20. pp. 273–291, May, 1905. Abstract of Monograph submitted to the Carnegie Inst. of Washington.)—The complete results of the work mentioned in Abstract No. 344 (1905). E. C. C. B.

1419. *New Spectrum observed in Gadolinium.* **G. Urbain.** (Comptes Rendus, 140. pp. 1233–1234, May 8, 1905.)—Gadolinium exhibits no absorption in the visible part of the spectrum, but it yields an ultra-violet absorption spectrum identical with that attributed by Crookes in 1898 to victorium. [See also Abstract No. 361 (1905).] T. H. P.

1420. *Inorganic Phosphorescent Preparations.* **E. Goldstein.** (Deutsch. Phys. Gesell., Verh. 7. 2. pp. 16–19, Jan. 30, 1905.)—The phosphorescence produced by the induced electric spark on various inorganic mixtures is described—chiefly of the sulphates of calcium, lithium, sodium, zinc, cadmium, and potassium, with various additions of manganese. C. P. B.

1421. *Experiments on Blondlot's "Heavy Emanation."* **R. F. Pozděna.** (Ann. d. Physik, 17. 1. pp. 104–131, June 9, 1905.)—A lengthy and detailed account of experiments made to determine whether an increase of brightness of a phosphorescent substance, due to the "emanation" described by Blondlot [see Abstract No. 2565 (1904)], can be systematically observed when the observer does not himself perform the exposure movements and is in ignorance thereof. The results are considered to prove that the apparent alteration in brightness is illusory; even if the emanation actually exists, which the author doubts, he holds that it is impossible to obtain confirmatory evidence by means of visual observations of a luminescent substance. L. H. W.

1422. *Photographic Action of Hydrogen Peroxide.* **J. Precht** and **C. Otsuki.** (Deutsch. Phys. Gesell., Verh. 7. 7. pp. 163–169, April 15, 1905. Ann. d. Physik, 16. 5. pp. 890–906, May 16, 1905.)—The authors reply to the observations and arguments brought forward by Graetz [see Abstract No. 1008 (1905)] in favour of the radiation explanation of the peculiar action noticed in the case of certain pictures formed on photographic plates. They again develop their own view that the effects are due to the chemical action of $H_2O_2$ (the explanation given by Russell), and call attention to the quite extraordinary sensitiveness of the silver-bromide-gelatine towards the influence of hydrogen peroxide. J. J. S.

1423. *Radium-bearing Springs in Colorado.* **W. P. Headden.** (Amer. Journ. Sci. 19. pp. 297–309, April, 1905. Abstract of paper read before the Colorado Scientif. Soc., Jan. 13, 1905.)—Analyses are given of the water from the Doughty Springs, and of the sinter deposited by them, which contains very large proportions of barium. A photographic test showed the presence of small amounts of radium in the sinter. T. M. L

## HEAT.

**1424.** *Dilatation and Compressibility of Mixtures.* **P. Carnazzi.** (N. Cimento, 9. pp. 161–174, March, 1905.)—Two mixtures are employed, and the percentages of the constituents are varied in each case; the first mixture consists of acetone and amyl alcohol, and the second of benzole and amyl alcohol. The graduation and filling of the dilatometer has previously been described in connection with experiments on mercury [see Abstract No. 85 (1904)]. Tables of results are arranged to show the observed dilatation and that calculated by using the additive law, the object being to test the applicability of this law. It is found that the coefficient of expansion of the mixture increases with rising temperature; and as the component of smaller coefficient is added to that of greater, the dilatation diminishes, but not according to the additive law. Further, the differences diminish with rise of temperature in the case of the first mixture, while in the second, they diminish with rise of temperature when the benzole is predominant, increase when the amyl alcohol is predominant, and remain constant when the constituents are nearly equal in quantity. The results for compressibility show that on passing by a gradual variation of composition from one pure constituent to the other, the compressibility gradually changes from that of the first to that of the second, and, in general, the coefficient of compressibility diminishes with increasing pressure; and that the additive law does not hold, the observed coefficient being generally less than that obtained by calculation, except in those cases where the coefficients of the two constituents differ very slightly. (In this case the errors of observation are probably larger than any real deviation from the additive law which might occur.) S. G. S.

**1425.** *Expansion of Jena and Thüringer Glass at Low Temperatures.* **H. Kamerlingh Onnes** and **W. Heuse.** (Konink. Akad. Wetensch. Amsterdam, Proc. 7. pp. 674–684, May 25, 1905. Communication No. 85 from the Phys. Laboratory at Leiden.)—At Leiden the hydrogen thermometer is taken as the standard for very low temperatures. To reach otherwise the degree of accuracy obtainable with this, it is necessary to know the expansion coefficient of Jena glass $16^{III}$ to about 1 per cent. The same determination has also been made for a sample of Thüringer glass. Both have been examined between + 16° C. and − 182° C., and an accuracy of 1 in 200 has been reached. The length readings were taken directly with a comparator at ordinary temperatures, at about − 90° C. and at about − 180° C. Writing $L = L_0 (1 + at + bt^2)$, the final values are as follows:—

Jena glass $16^{III}$ $a = 7{\cdot}74 \times 10^{-6}$, $b = 0{\cdot}00882 \times 10^{-6}$;
Thüringer glass (No. 50) $a = 9{\cdot}15 \times 10^{-6}$, $b = 0{\cdot}0119 \times 10^{-6}$.

[See also Abstract No. 1387 (1903).] E. H. B.

**1426.** *Importance of Accurate Measurements at very Low Temperatures.* **H. Kamerlingh Onnes.** (Chem. News, 91. pp. 137–139, March 24; 149–150, March 31; 156–157, April 7; 174–175, April 14; and pp. 181–183, April 20, 1905. Address in commemoration of 329th Anniversary of University of Leiden. From communications from the Phys. Lab., University of Leiden, Supplt. No. 9. Nos. 85–96.)—In this address there is given not only an interesting historical account of the attempts, successful and unsuccessful, made to liquefy gases from the days of van Marum up to the present time, but also an account of the development of the Leiden cryogenic laboratory, and a description of the field of work which lies before it and similarly equipped laboratories. The author indicates the extensive field which must still be covered before a complete survey of the equations of state can be obtained. "To get to know the equations of state of the best known substances with sufficient accuracy down to the lowest temperatures seems, indeed, a task which will take up the greater part of the forces of experimental physics during the whole of the twentieth century." In the historical survey the names of Hampson and Travers are not even mentioned, although a great deal is said about Dewar and Linde. F. G. D.

**1427.** *Heat of Vaporisation of Liquefied Gases.* **E. Mathias.** (Comptes Rendus, 140. pp. 1174–1176, May 1, 1905.)—Let $f$, $s$, $s'$, $\lambda$ represent the saturation pressure, the specific volumes of saturated liquid and vapour, and the heat of vaporisation, at temperature $t$; then if, while liquid at $t$ evaporates, cooling is prevented by the addition of $h$ calories for every gramme lost by the containing vessel, $\lambda = h(1 - s/s')$; but by Clapeyron's equation $\lambda = t(s' - s)df/dt$; hence $s' = h/t(df/dt)$. Now the author's experiments on $CO_2$ show that this expression for $s'$ has for each value of $t$ a determinate value independent of the actual masses of liquid and vapour present, so that the univariance of the saturated states in equilibrium is experimentally demonstrated. For $CO_2$ the value of $h$ tends to 25·26 at the critical point. But experiment, while giving for $h$ the value 30·9 at 30·59°, gave 18·6, 19·8, 15·2 respectively at 30·82°, 30·97°, 31·16°, indicating that, while at 30·59° the liquid exists still in presence of the saturated liquid with its regular properties, the regular liquid state no longer exists at and above 30·82°, and that the transformation of the liquid phase into the vapour phase has already begun. R. E. B.

**1428.** *Effect of Temperature on Thermal Conductivities of Electrical Insulators.* **C. H. Lees.** (Roy. Soc., Phil. Trans. 204. pp. 433–466, May 31, 1905. Roy. Soc., Proc. 74. pp. 337–338, Jan. 23, 1905. Abstract.)—The substance is cast in a cylindrical brass tube which is surrounded by liquid air; thus the outside is a practically isothermal layer. A platinoid wire parallel to the axis of the cylinder carries current, and thus acts as a linear generator of heat within the material. The difference of temperature existing between two lines parallel to the axis is determined from measurements of the resistances of two platinum spirals. The heating wire is duplicated, so that the spiral which is in one experiment the hotter, may in the next experiment be the cooler, thus connecting for want of symmetry in the apparatus. The design, filling, and calibrating of the apparatus are fully described, and a section of the paper is given up to a mathematical discussion of the conditions of the experiment. It is shown that the conductivity of the substance can be determined from the dimensions of the apparatus, the rate of production of heat in the platinoid wire, and the difference of temperature between the spirals; unless this difference of temperature is great, it is independent of time, *i.e.*, the calculated conductivity is independent of the maintenance of temperature equilibrium. The substances experimented on are paraffin wax, naphthalene, $\beta$-naphthol, ice, glycerine, aniline, diphenylamine, and pure nitrophenol. Tables of the conductivities at temperatures varying from the atmospheric temperature down to, in some cases, $-195°$ are given, and the temperatures are expressed on both platinum and hydrogen thermometer scales. The conductivity of ice, naphthalene, aniline, and nitrophenol increases as the temperature falls, and the same is the case to a slight extent with $\beta$-naphthol and diphenylamine, and probably paraffin wax. In the case of glycerine there is an increase down to $-80°$, and beyond this a decrease. S. G. S.

**1429.** *Determination of Heats of Mixing.* **B. M. Clarke.** (Phys. Zeitschr. 6. pp. 154–159, March 1, 1905.)—Results are given of measurements by the ice-calorimeter of the amounts of heat evolved when the following liquids are mixed in various proportions: (1) ethyl alcohol and water; (2) aniline and xylol; (3) propyl alcohol and water; (4) chloroform and ether; (5) xylol and amyl alcohol; (6) chloroform and xylol; (7) ethyl alcohol and amyl ether. For some of these mixtures the changes in volume are also given, and the curves connecting these numbers with the percentages by weight of the mixture bear a striking resemblance to those given by the heat evolutions. In some cases, however, the parallelism is not sustained. T. H. P.

**1430.** *Thermodynamics of Capillarity.* **Ponsot.** (Comptes Rendus, 140. pp. 1176–1179, May 1; and pp. 1236–1238, May 8, 1905.)—Suppose the surface separating a liquid from its vapour to be inside a capillary tube which connects two cylindrical vessels, fitted with pistons and containing respectively the main bodies of the liquid and vapour, the respective pressures on which are $p$ and $f$. For given masses the state of the system may be defined by the temperature T and by the surface $s$ of the liquid, and if V, V′ are the volumes of the liquid and vapour respectively, and E the energy of the whole mass, we may write $dE + p\,dV + f\,dV' = dH = K\,dT + L\,ds$, whence $L/T = \partial(p, V)/\partial(T, s) + \partial(f, V')/\partial(T, s)$. In the first memoir, in which the capillary tube is taken to be conical, this equation is transformed, and from certain considerations it is concluded that Kelvin's expression $-T(\partial\mathfrak{T}/\partial T)$ for the latent heat of surface-extension ($\mathfrak{T}$ being the surface-tension) is incorrect: [but the transformation itself, which involves partial differential coefficients, seems faulty.] In the second memoir the capillary tube is taken to be cylindrical, and the equation becomes $L/T = (\partial p/\partial T)(\partial V/\partial s) + (\partial f/\partial T)(\partial V'/\partial s)$: then the hypothesis $\partial V'/\partial s = -\partial V/ds$ [coupled with the *unstated assumption* $\partial E/\partial s = 0$] gives $(p - f)/T =$ constant, which is contrary to fact, so that the hypothesis is wrong [at least, if the assumption is correct]. R. E. B.

**1431.** *Relation of Specific Heat to Atomic Weight in Elements and Compounds.* **W. A. Tilden.** (Chem. Soc., Journ. 87. pp. 551–564, April, 1905.)—From the results of his own work and that of other investigators, the author draws the following conclusions. The influence of temperature on the specific heats of many elements and compounds is much greater than has been formerly supposed. There appears to be no one condition or set of conditions under which the law of Dulong and Petit is true for all the elements. The nearest approach to a constant available for practical purposes is found by taking the mean specific heats of metals between the freezing- and boiling-points of water, recognising Gl, B, C, and Si as exceptions, together with H, O, N, and perhaps Cl in the solid form. It is possible that the atomic heats of elements in the gaseous state may be equal, direct experiment on the gases having led to the value 2·4 for hydrogen, 2·5 to 2·7 for oxygen, and 2·6 for carbon (in $CO_2$). The independence of each atom in an element or compound must be regarded as a fact of the utmost importance from a theoretical point of view. That the molecular heat of a compound is the sum of the atomic heats of all the elements present is in harmony with the results of observations on other additive properties, such as specific volume and specific refraction. Such independence suggests the idea that chemical combination results from the mechanical fitting together of atoms, so that a section through a mass would exhibit, if the atoms were visible, a certain tactical arrangement probably corresponding with the closest approximation possible under prevailing conditions. It has yet to be shown that chemical combination results, in all cases, from the existence of electric charges resident on the atoms or in electrons associated with them. The molecules of carbon compounds, especially, may be regarded as being probably formed by the adjustment of the constituent atoms to one another in respect of space, and it is noteworthy that the binary compounds of carbon, the hydrides, chlorides, and oxides, when in the liquid state, are not electrolytes, and no case is known of the electro-deposition of carbon from such compounds in the elemental form. [See also Abstract No. 1081 (1904).]

T. H. P.

1432. *Dependence of Free Energy upon Temperature.* **J. E. Trevor.** (Journ. Phys. Chem. 9. pp. 299–310, April, 1905.)—This paper contains a critical examination of the theoretical results arrived at in two recent papers dealing with the thermodynamic theory of free energy [Richards, Abstract No. 678 (1903); van't Hoff, Abstract No. 2230 (1904)]. Van't Hoff arrived at the equation $E = E_0 + AT - ST \log T$, where E is the increase of free energy corresponding to a specified isothermal variation of state. It is shown that an equation of this form does hold good, but not with the meanings which van't Hoff attaches to the symbols. In Richards' paper the hypothesis is made that $\partial \Delta f/\partial\theta = -M\partial\Delta e/\partial\theta$, where $\Delta f$ and $\Delta e$ are the variations of specific free energy, and specific total energy corresponding to a specified isothermal variation of state, and M is a quantity independent of temperature. It is pointed out that from the principles of thermodynamics such a relationship cannot be deduced, and that the thermodynamical relationship is $\partial\Delta e/\partial\theta = -\theta\partial^2\Delta f/\partial\theta^2$. This does not necessarily exclude the validity or approximate validity of Richards's equation, and so its exact meaning and consequences are very fully discussed. F. G. D.

## REFERENCES.

1433. *Hirn's Experiment for Determining the Mechanical Equivalent of Heat by the Heat Developed by Shock.* **P. V. Koturnitzky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 1. pp. 11–13, 1905.)—An attempt to verify the usual theoretical formulæ for the shock of elastic bodies, by means of the experimental data obtained by Hirn in his experiments for determining the mechanical equivalent of heat led the author to doubt the precision of certain of Hirn's measurements. It is suggested, however, that Hirn's arrangement might be very serviceable in clearing up some of the numerous and varied questions that are connected with the occurrence of shock between two similar or dissimilar bodies. D. H. J.

**1434.** *Water at High Temperatures.* **C. Dieterici.** (Ann. d. Physik, 16. 5. pp. 907–930, May 16, 1905.)—A continuation of the complete paper [see Abstract No. 1238 (1905)], which has already been summarised [see Abstract No. 123 (1905)]. R. E. B.

**1435.** *Vapour Pressure of Solid Solutions.* **A. V. Speranski.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 186–212, 1905.)—This paper contains a detailed account of the author's investigation of the vapour pressure of solid solutions of (*a*) naphthalene and β-naphthol; (*b*) *p*-dibrombenzene and *p*-dichlorbenzene; (*c*) *p*-dibrombenzene and *p*-chlorbrombenzene. The main results of the work have been already published [see Abstracts Nos. 1091 (1904) and 880 (1905)]; the chief conclusion is that the laws of vapour pressure are the same for solid as for liquid solutions. The molecular weight of *p*-$C_6H_4Br_2$ in dilute solid solutions is simple, whilst β-naphthol has approximately a double value for the molecular weight. D. H. J.

**1436.** *Contact Phenomena in Flames under the Influence of Solid Bodies.* **A. A. Baikoff.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 156–169, 1905.) —A more extended description of the investigation of which an account is given in Abstract No. 552 (1905). According to the author, the difference in the luminosity of solid bodies on heating them in one and the same flame is due to the difference of temperature of the bodies. D. H. J.

**1437.** *Heat of Vaporisation of Oxygen and Nitrogen.* **H. Alt.** (Phys. Zeitschr. 6. pp. 346–349, June 1, 1905. Communicated by the Phys. Inst. der Techn. Hochschule, München.)—A continuation, with increased precautions, of former work [see Abstract No. 1698 (1904)]. For oxygen the heat of vaporisation is found to drop, but not uniformly, from 55·5 cal. at 35 mm. pressure to 51·1 cal. at 705 mm.; for nitrogen it falls from 51·7 cal. at 94 mm. to 47·9 cal. at 713 mm., also not uniformly. R. E. B.

**1438.** *Stability of a Fluid.* **O. Tumlirz.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 167–187, Feb., 1905.)—Discussion of the stability of a fluid to which properties are assigned which amount to the assumption of van der Waals' equation for the characteristic. The conclusions are, of course, those that are well known. R. E. B.

**1439.** *Thermodynamics.* **K. v. Wesendonk.** (Ann. d. Physik, 16. 3. pp. 558–564, March 14, 1905.)—The difficulties in utilising the changes of energy in chemical reactions are practical only, and not theoretical; the products of combustion have not necessarily greater entropy than their components before combustion; though heat and chemical energy are hard to distinguish, the utilisability of changes of the latter may be perfect. R. E. B.

**1440.** *Difference of Temperature of Bodies in Contact.* **E. Rogovski.** (Comptes Rendus, 140. pp. 1179–1181, May 1, 1905.)—In continuation of former work [see Abstracts Nos. 569 and 1439 (1904)], the dependence of the difference in temperature of a silver wire and the water which surrounds it on (1) the flux of heat across the surface of separation, (2) the diameter of the wire, (3) the actual temperature of the water, (4) the rate of flow of the water, is investigated. R. E. B.

**1441.** *The Constant of Mariotte's and Gay-Lussac's Law.* **G. Meslin.** (Journ. de Physique, 4. pp. 252–256, April, 1905.)—The gas constant R when calculated for molecular quantities is twice the mechanical equivalent of heat. This, the author says, has no real physical significance, but is due to the assumption of the mass of the hydrogen molecule as being equal to 2. E. C. C. B.

## SOUND.

**1442.** *Vibration of Resonance Boxes.* **T. Terada.** (Mathematical and Physical Soc., Tokyo, 2. 21. pp. 332–334, 1905.)—In this, the second part of the author's paper [see Abstract No. 1256 (1905)], he deals with the resistance of the aperture of a cylindrical resonator. Besides the elliptical apertures already dealt with by Helmholtz and Rayleigh, the author also deals with rectangular apertures. The conductivity is in all cases less than that required by Rayleigh's formula. This may be attributed to the fact that that formula supposes the mouthpieces to be made of a plate of thin metal of large area. The walls of a narrow tube produce a considerable constraint, which increases as the shape of the aperture diverges from the circular shape. The divergence is therefore very great with square apertures.
E. E. F.

**1443.** *Propagation of Sound in a Tube.* **J. Violle and T. Vautier.** (Comptes Rendus, 140. pp. 1292–1298, May 15, 1905. Annal. Chim. Phys. 5. pp. 208–245, June, 1905.)—Musical notes were transmitted along a tube 3 m. in diam. and 2,922 m. long, extending in a straight line from Argenteuil to Cormeilles, and closed at both ends by diaphragms which reflected them. On transmitting musical notes of different pitches along the tube, the authors found that the distance over which they are audible varies inversely as the square root of the pitch, a result which is in accordance with Rayleigh's theory. Notes produced by different musical instruments retain their rhythm, pitch, and quality unchanged. Within the whole range comprised between $ut_{-1}$ and $mi_4$, the speed of propagation does not alter by 0·1 per cent. But after reflection, there is a retardation of the harmonics behind the fundamental, the highest harmonics being least retarded. The amount of retardation is independent of the pitch of its fundamental and of the kind of instrument employed.
E. E. F.

**1444.** *Transverse Sound Sheets.* **V. Hensen.** (Ann. d. Physik, 16. 5. pp. 838–864, May 16, 1905.)—Further evidence as to the existence of a gaseous transverse sheet and its function in producing various classes of sounds is accumulated. The author believes that strong and rapid motions of fins in water produce sounds of a very low pitch. These sounds are inaudible to the human ear, but the auditory ossicles of fish are much coarser than the human ones, and are probably adapted to the perception of these low vibrations. By the impact of a moving air sheet upon a solid wedge, or by a regular succession of explosive incursions of a mass into a sheet of fluid at rest or in uniform motion, or in general, by the periodical accumulation and dissipation of masses, a class of musical notes may be produced independently of resonance. When a steady stream of air is driven into a tube, as in the case of an organ-pipe or the human larynx, a transverse sheet breaks up the current into pulses and produces the note.
E. E. F.

**1445.** *Vibration Forms of the Edelmann Tuning-forks.* **P. Ostmann.** (Phys. Zeitschr. 5. pp. 825–828, Dec. 15, 1904.)—The vibrations are observed by the microscope method, and are found to be not longitudinal but transversal.
J. W. P.

# ELECTRICITY AND MAGNETISM.

## THEORY, ELECTROSTATICS, AND ATMOSPHERIC ELECTRICITY.

**1446.** *Motion of Electrons in Metals.* **H. A. Lorentz.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 565–573, Feb. 8, and pp. 710–719, April 5, 1905. Proc. 7. pp. 588–593, March 22, and pp. 684–691, May 25, 1905).—By a continuation of reasoning similar to that of a previous paper [see Abstract No. 577 (1905)] expressions are obtained in the first paper for the Peltier effect, the Thomson effect, and the Hall effect. The possibility of accounting for the various phenomena upon the hypothesis of negative free electrons only is discussed. It is, however, pointed out that one reason for admitting the existence of positive free electrons also lies in the fact that the Hall effect has not the same direction in every metal. The second paper proceeds to examine the consequences of the assumption of *two* kinds of free electrons—positive and negative ones. In this case the electric current per unit area of the normal section, is the sum of the currents due to the positive and the negative particles. Similarly the conductivity is the sum of what may be termed the *partial conductivities* due to the two kinds of electrons. In all the other problems that have been treated in preceding parts of this discussion, a serious difficulty is now encountered under the present assumptions. If either the nature of the metal or the temperature changes from one section of the circuit to the next, it is easy to conceive a state of things in which there is nowhere a continual increase of positive or negative electric charge ; this simply requires that the *total* electric current be zero for every section of an open circuit, and that it have the same intensity for every section of a closed one. But, without the introduction of rather artificial hypotheses, it is in general found impossible to make each *partial* current (*i.e.*, the current due to each kind of electrons considered by itself) have the same property. The consequence will be that the number of positive as well as that of negative electrons will increase in some places and diminish in others, the change being the same for the two kinds, so that one might speak of an accumulation of " neutral electricity " at some points and a diminution of this quantity at others. In spite of the difficulties of the problem it is proceeded with so far as to obtain expressions which represent the law of the thermoelectric series, the Peltier and Thomson effects being not entered on. In conclusion, it is stated that it may be found advisable in the theory to confine attention to one kind of free electrons. But, if a further study of the Hall effect should prove the necessity of operating with both positive and negative free electrons, then it would become imperative to face all the difficulties attending that assumption. E. H. B.

**1447.** *Electromagnetic Field due to a Constant Helicoidal Current; Theory of the Solenoid.* **G. Picciati.** (Accad. Lincei, Atti, 14. pp. 823–331, March 19, and pp. 443–450, April 16, 1905.)—A mathematical discussion of the electric and magnetic potentials due to a helicoidal current, and from which the magnetic field is derived. When the ratio of the step of the helix to its radius is small, the well-known form of the field is obtained. [See also Abstract No. 576 (1905).] In the second paper the electrical and magnetic fields due to a helical current are expressed in helical co-ordinates and are developed in terms of Hankel's cylindrical functions. The author finds that at points on the axis the magnetic and electric fields are at right angles to each other, the electric field being directed along a normal to the helix, and the magnetic field making a constant angle with the axis. When the step of the helix is very small compared with the radius, the electric field inside the solenoid disappears and the magnetic field has the value $4\pi nI$ and is parallel to the axis. For external points the magnetic field is zero and the electric field is directed along a normal to the helix; its value is given.

S. G. S.

1448. *Electromagnetics in a Moving Dielectric.* **O. Heaviside.** (Nature, 71. pp. 606–607, April 27, 1905.)—Some time ago, when considering the assumption that the ether inside a body is quite stationary when a body is moved, and that in the application to Maxwell's ethereal equations this involves the use of a fixed-time differentiator for the ether, and a moving one for the matter, the author argued that the same applied not only to the electric polarisation, as done by Lorentz and by Larmor, but also to the magnetic polarisation. At that time the application was to plane waves only. It is now extended to the general case. This is here indicated, and it is noted that in some cases this extension of treatment to the magnetic polarisation simplifies instead of complicating the force formulæ. [See also Abstract No. 633 (1904).] E. H. B.

1449. *Electronic Theory of Magnetism.* **P. Langevin.** (Annal. Chim. Phys. 5. pp. 70–127, May, 1905.)—A mathematical discussion of magnetism from the conception of the ampère currents being due to the periodic movements of electrons within the molecule. Among the conclusions arrived at the following appear specially noteworthy: 1. These ampère currents, due to circulation of the electrons, constitute the circuits of no resistance of Weber's diamagnetic theory, with this peculiarity, that the currents remain constant, as supposed by Weber, only if the inertia of the electron is entirely of electromagnetic nature. 2. All the facts of magnetism and diamagnetism may be traced to the currents due to the motion of electrons in circuits of zero resistance and very great inductance, to which all the ordinary laws of induction are applicable. E. H. B.

1450. *Impossibility of Demonstrating the Earth's Motion of Translation.* **P. Langevin.** (Comptes Rendus, 140. pp. 1171–1173, May 1, 1905.)—The negative result of Trouton and Noble's experiment [see Abstract No. 1994 (1904)] is explained if, for the condenser considered, the difference between its electric and magnetic energies is independent of the orientation of its plates with respect to the direction of its movement. Now this follows on Lorentz's principle if in consequence of its motion the condenser were to contract in the ratio $\sqrt{(1+\beta)}$ in the direction of its motion, since then the difference between these energies would be $L\sqrt{(1-\beta^2)}$, where L is their difference for the condenser at rest. R. E. B.

1451. *Action of Radium Rays on Electrification by Contact.* **N. A. Hesehus.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 29–33, 1905.)—The experiments described were made in 1903 by the author in collaboration with N. Georgiewsky. (1) A piece of sulphur which has been exposed for a *short* time to the action of radium rays becomes negatively electrified if rubbed or brought in contact with another piece of sulphur which has not been so exposed ; if it is exposed for a *long* time (say some hours) it becomes positively electrified. The same is true when ebonite or selenium are used instead of sulphur. Hence it is clear that the action of radium rays is at first a heating one, then, later, a dissociating action (production of ions and electrons). (2) If glass, quartz, or mica are examined in the same way as the above three bodies, they show positive electrification only, whether the exposure is for a short or long time. It is worth noting that these bodies are themselves positive to the substances under (1), and consequently possess a greater capacity for dissociation. (3) The influence of radium on the contact electrification of metals is negligible in amount. Experiments are difficult. D. H. J.

1452. *Lichtenberg's Figures.* **W. Holtz.** (Phys. Zeitschr. 6. pp. 319–328, May 15, 1905.)—The first part of the paper is a historical sketch of the different experiments and theories concerning the Lichtenberg's figures. The mode of obtaining the figures used by the author is then described, together with one or two experiments performed with the object of disproving the hypotheses of Bezold and Reitlinger. According to the former, the air is driven from a point when negatively charged, and towards the point when positively charged ; and according to the latter, the negative figure is produced by air driven outwards, and the positive figure by particles torn from the electrode. Several illustrations of beautiful and interesting figures then follow. S. G. S.

1453. *Diurnal Variation in Electric Dissipation and Atmospheric Dust on the Patscherkofel.* **H. v. Ficker** and **A. Defant.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 151–165, Feb., 1905. Inst. f. kosmische Physik d. Univ., Innsbruck.)—The authors determined the electric dissipation with the aid of a Günther-Tegetmeyer instrument, and the dust with the aid of a dust-meter, made by Plath of Potsdam, on the Aitken principle. The observations were taken in the last week of Dec., 1904, when the mountains were deeply covered with snow. The dissipation curves resemble those which Conrad obtained on the Sonnblick [see Abstract No. 1456 (1905)]. The number of dust particles increases as the temperature rises ; before sunrise and after sunset there may be no dust at all ; the maximum occurs in the afternoon, and a marked diminution does not begin until about sunset. Before sunrise $a-$ has a maximum ; with rising run and dust percentage $a-$ decreases rapidly, $a+$ increases. There is a minimum in the dissipation between 11 and 12 a.m., and a second, more pronounced minimum between 2 and 3 p.m. The differences in $a-$ and $a+$ and in the dust are connected with convection currents, as Elster and Geitel assumed. The pressure of dust keeps the dissipation low, but there is no parallelity. There may be pronounced dissipation in a dust-free atmosphere, and Aitken's instrument, therefore, indicates only dust particles, not ions. H. B.

1454. *Electricity Dissipation at Kremsmünster* (1903 *and* 1904). **P. B. Zölss.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 189–331, Feb., 1905. Phys. Zeitschr. 6. pp. 129–132, March 1, 1905. Abstract.)—The observations of F. Schwab [see Abstract No. 1484 (1904)] have been continued. The author tabulates the material collected in the period, May, 1903, to August, 1904, and briefly discusses the results of the 10,000 observations, taken during the summer months every hour between 8 a.m. and 8 p.m. The electroscope is charged to about 200 volts and exposed for a period of over 15 min. The mean annual curve for 1903 agrees with that of 1902; but in the hot, dry summer of 1904 the dissipation and the *q* values were low instead of high. The diurnal means of *q* are regular, the values for single days very irregular. In order to investigate the connection between the fluctuations in the barometer and in the dissipation, the author himself took, during September and October, 1904, observations in a cave near by which, though closed by a door, communicates through a few holes, together only a few dm.$^2$ in section, with the outer air; the temperature in this cave was fairly constant at 9·4° C., the relative humidity 96 per cent. These observations decidedly support Ebert's view that the ionisation decreases when the barometer rises, even for extreme variations in the ionisations. The *q* was, however, only 0·94—that is, the positive ions did not predominate—and similar observations in the observatory basement (stone floor) did not point to any inverse parallelity between the air pressure and the dissipation. The material collected by Schwab, moreover, shows this connection only in the means, and some other influence, probably solar radiation, seems to prevail. H. B.

1455. *Dissipation of Atmospheric Electricity in Relation to Meteorology at Trieste.* **E. Mazelle.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 399–501, March and April, 1905.)—The Observatory at Trieste is provided with a Benndorf self-registering electrometer, an Exner portable electroscope, and a Günther dissipation apparatus of the Elster-Geitel type. Only dissipation values are discussed in this paper, the regular observations having been made by the author (in the vacations by A. Faidiga) between 11 and 12 (noon) in the period March 1902, to November 1903. When all the observations are utilised, the dissipation shows a double annual period, with maxima in April and September and minima in February and June; when probable values are considered there is a single period, maximum in summer, minimum in winter. The dissipation of negative charges is predominant (72 per cent.), and there is a direct connection with the wind-strength, which increases both the dissipations, and especially the positive, at the average rate of 3 per cent. per km.; during strong winds of more than 50 km. per hour, the positive dissipation predominates therefore; the various kinds differ, however, and winds from the sea favour negative dissipation. When the wind effect is deducted a positive temperature coefficient, an increase in the dissipation of 2 per cent. per 1° C., becomes apparent. Increase in the relative humidity diminishes the dissipation; in dry air and with a clear sky the negative dissipation is more marked, and an increase in the vapour pressure has the same influence. With cloudy skies and during rains the dissipation values are small. A connection between dissipation and air pressure cannot be established; cyclones and anticyclones yield the same mean values. H. B.

1456. *Atmospheric Electricity in Relation to Meteorology on the Sonnblick.* **V. Conrad.** (Akad. Wiss. Wien, Sitz. Ber. 114. 2a. pp. 335–358, March and April, 1905. Phys. Zeitschr. 6. pp. 406–409, July 1, 1905.)—The author discusses about 800 observations, taken in less than five weeks (August, 1903) on the Sonnblick and in the valley below, at Bucheben, 1,203 m. above sea-level. The dissipation values are high at high barometer; the influence of the rise and fall of the barometer is not distinct, however, though a simultaneous barometric movement in the same sense (rise or fall) both at the top and below seems to raise the dissipation values. On the Sonnblick the dissipation increases as the thermometer goes up to 8° or 5° C., and decreases then with further rising thermometer; when the temperature rises below (at Bucheben) the dissipation above diminishes. An ascending air current seems to carry the valley air, which is poor in ions, up the mountain, while descending currents bring air richer in ions to the mountain, and increases the dissipation. The daily course of the dissipation, and, further, the fact that east wind, the only pure mountain wind on the Sonnblick, gives very high dissipations, support this view. In arriving at these conclusions abnormal values observed during severe thunderstorms and heavy mists were disregarded; the $q$ were high after mists and precipitations, which would appear to indicate that, contrary to C. T. R. Wilson, the condensation of water vapour may take place on the positive ions in the first instance. H. B.

**1457.** *Continuous Observations of the Rate of Dissipation of Electric Charges in the Open Air.* **C. C. Farr.** (Roy. Soc., Proc. Ser. A. 76. pp. 152–159, May 24, 1905.)—During the latter part of 1902 and the first months of 1903 the author took, with Elster-Geitel apparatus, as many consecutive observations as possible, for periods of 24 hours and longer, of the rate of dissipation of positive and negative charges on Canterbury Plains in New Zealand, 20 ft. above sea-level, 20 miles west of the coast. The potential difference between a point 10 ft. above the surface and the earth, further, wind strength and direction, and relative humidity were also determined. On the whole the $q$ were greater than 1 (about 1·2); when lower values of $q$ (down to 0·4) were observed there was frequently, but not always, a reversal in the sign of the atmospheric charge. The conductivity of the air was sometimes very high, which seems to be connected with the wind strength rather than its direction, but not apparently with the humidity. On two days the wind blew from the northwest, *i.e.*, from over the mountains, which may rob the air of its positive ions, owing to the denser negative charge on the peaks (Elster-Geitel); this would account for the high negative charge observed on the Plains during those and "Foehn" winds. H. B.

## DISCHARGE AND OSCILLATIONS.

**1458.** *Ionisation in Flames.* **P. Massoulier.** (Comptes Rendus, 140. pp. 1023–1024, April 10, 1905.)—The author has previously shown [see Abstracts Nos. 606 and 801 (1905)] that ether flames are the seat of considerable ionisation, which depends not only on the temperature, but also on the chemical reactions occurring in the flames. The introduction of $CO_2$ into the flames conditions a marked lowering of the temperature and a considerable increase in the intensity of the current under constant voltage. Thus, using electrodes 2 mm. apart and 2 mm. above the flame (formed by burning 80 litres of air saturated with ether vapour per hour) with a voltage of 88, the following results are obtained; When no $CO_2$ is present, the electrodes become pale orange and the current obtained is $28 \times 10^{-8}$ amp., whilst when 36 litres of $CO_2$ are supplied per hour, the electrodes remain red and the current is $82 \times 10^{-8}$ amp.; with 66 litres of $CO_2$ per hour, the electrodes remain black, and the current is $66 \times 10^{-8}$. These results are readily explained by supposing that the $CO_2$ is dissociated in the flame, and that this dissociation lowers the temperature by absorbing heat, and also helps very considerably in the production of ions, since the current is increased threefold in spite of both the great diminution of the mobility and the increased current of gas, which allows a larger number of ions to escape. If the $CO_2$ introduced is replaced by air, which is not capable of dissociating, the temperature varies but little, and, indeed, appears to rise, while the current is considerably diminished. T. H. P.

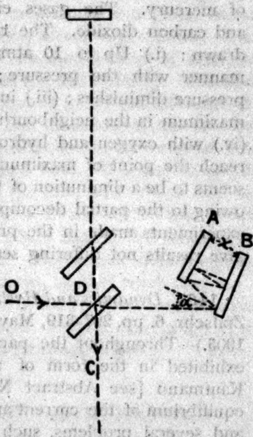
1459. *Sparking Distance.* **W. Voege.** (Elektrotechn. Zeitschr. 26. pp. 360–362, April 20, 1905.)—Recent experiments on the relation connecting spark-length with p.d. [see Abstracts Nos. 2718 (1904) and 389 (1905)] render it extremely probable that beyond a certain distance this relation is a linear one, and that at the electrodes there exists a certain transition or contact resistance which decreases with increasing spark-length, becoming constant beyond a certain sparking distance. The author describes experiments (1) to determine whether the law $Y = At + B$ [see Abstract No. 389 (1905)] found by him is appreciably affected by external conditions, such as the presence of substances capable of ionising the air in the neighbourhood of the electrodes; and (2) to arrive at some explanation of the contact resistance and the region of instability in the curves connecting p.d. with spark-length. For the production of ions in the neighbourhood of the electrodes, the author employed (*a*) a Bunsen flame; (*b*) the burner of a Nernst lamp; and (*c*) a pure platinum wire maintained at a dull-red heat. The results may be summed up as follows. The introduction of ions of the same polarity as the electrode into its neighbourhood produces no effect on the discharge. On the other hand, the introduction of positive ions into the neighbourhood of the kathode favours a discharge; of negative ions, hinders it. The author was led to conclude that the greater part of the resistance at the anode is due to the presence of a layer of negative ions. Further experiments confirmed this surmise. Thus, by touching a plate anode with a rod of insulating material, and thereby breaking through the layer of negative ions, a discharge is precipitated, and the spark passes from the precise point of the plate electrode which was touched. Further experiments are described. Dealing next with the region of instability in spark-length determinations, the author suggests the following explanation. With a short distance between the electrodes, the negative ions projected by the kathode reach the neighbourhood of the anode, thereby increasing the resistance at the latter. As the electrode distance is increased, this effect decreases until it almost ceases; but when this limiting distance is reached, a sudden rise of p.d. may still *occasionally* enable the negative ions sent out by the kathode to reach the neighbourhood of the anode—hence the uncertainty of the results observed at this point. A. H.

1460. *Glow Discharge in the Vapours of Mercuric Chloride, Bromide, and Iodide.* **W. Matthies.** (Deutsch. Phys. Gesell., Verh. 7. 8. pp. 189–193, April 30, 1905. Communication from the phys. Inst. d. Univ., Erlangen.)—The external form of the glow discharge in the vapours of the halogen compounds of mercury—which is accompanied by extremely brilliant electroluminescence—does not differ essentially from that obtained in elementary gases. With the particular tubes used, stratification of the positive light is comparatively rare; when it is observed, sharply defined plate-like discs of light are seen. With pressures up to 2 mm. of mercury the positive light regularly fills the cross-section of the tube, but at higher pressures it becomes limited to the immediate neighbourhood of the anode. When the current intensity is increased, however, it grows to a thread of light 0·5–0·8 cm. thick, which may reach nearly to the kathode; in many cases, mercury lines appear, similar to those obtained with the arc-discharge. All the author's experiments confirm the observation of Wiedemann and Schmidt, that with the strengths of current employed, and using platinum electrodes, no appreciable decomposition occurs in these vapours. Compared with nitrogen, the haloid compounds of mercury show exceedingly high potential gradients and kathode- and anode-falls. On the positive, non-stratified glow the gradient is not constant, but increases from the kathode towards the anode. In the Faraday dark space the gradients are considerably smaller than on the positive glow. The gradients increase with, but more slowly than, the pressure. The dependence of the gradients on the current strength is very complicated, and varies considerably for different pressures: at high pressures, it is in general much greater than at low ones. The normal kathode-falls increase approximately proportionally with the molecular weight of the compound.

T. H. P.

1461. *Short Spark-discharges.* **C. Kinsley.** (Phil. Mag. 9. pp. 692–708, May, 1905. Paper read before the Amer. Physical Soc.)—C. W. Chamberlain, according to the author, first showed that Michelson's interferometer can be modified so as to give measurements of the order of 2 $\mu\mu$, whereas in the old form it was not effective much below 20 $\mu\mu$. Light proceeds from O to D; one path is towards plate B, not set perpendicular to the light as usual, but inclined. Another plate A is inclined to B, so that the light reflected from B falls on A, and then undergoes several reflections and returns to D on the same path. If the body whose movement is required carries B, any movement is multiplied $n$ times by the multiple reflection and the interferometer becomes $n$ times as sensitive. In measuring sparking distance the author has one surface fixed and the other attached to B. The experiment consists in finding the relation of p.d. between the discharge surfaces to distance between them. Shaw [see Abstract No. 2298 (1904)] carried this investigation to the low potential $\frac{1}{8}$ volt, and found a linear relation. The author also finds a linear relation, but the potential gradient seems to vary according to treatment of the surface and atmospheric conditions. An appendix is given on coherer-action between the discharge surfaces.

P. E. S.



1462. *Potential Gradient in the Mercury Arc.* **J. Pollak.** (Phys. Zeitschr. 6. pp. 277–281, May 1, 1905. Écl. Électr. 43. pp. 422–424, June 17, 1905.)—An investigation into the potential gradient along the mercury arc by means of an exploring electrode. It was found that the gradient is perfectly constant throughout the unstratified discharge, and somewhat smaller in the kathode dark space and close to the anode. The current employed was 6·1 amps., the distance between the electrodes 45 cm., and the total potential fall 21·8 volts.

E. C. C. B.

1463. *Ionic Velocities and Spark-length in Liquids.* **K. Przibram.** (Phys. Zeitschr. 6. pp. 276–277, May 1, 1905.)—The author has already shown [see

Abstract No. 1295 (1905)] for gases that the length of the brush discharge is less, all the greater the velocity of the ions moving from the discharging point to a plane. He has also measured the length of the positive and negative brushes and the sparking distance between a point and a plane in different liquids [see Abstract No. 3277 (1904)]. These should correspond to different ionic velocities in the liquid. The velocities are determined in a rough comparative manner by finding the fall in potential near to a charged conductor immersed in the liquid; J. J. Thomson having shown, for gases, that the ratio of the positive to the negative ionic velocity is approximately the ratio of the fields. For eight liquids the ratios (kathode fall) / (anode fall) and (positive spark) / (negative spark) are found and agree fairly well considering the roughness of the methods used. Hence the relation between spark-length and ion velocity is the same for liquids as for gases. R. S. W.

**1464.** *Electrostatic Rigidity of Gases at High Pressures.* **C. E. Guye** and **H. Guye.** (Comptes Rendus, 140. pp. 1320–1322, May 15, 1905.)—The authors have found the potentials required to produce sparking between platinum electrodes 0·2 mm. apart, at pressures varying from 2·07 to 65·1m. of mercury. The gases employed were nitrogen, air, oxygen, hydrogen, and carbon dioxide. The results are given, and the following conclusions drawn: (i.) Up to 10 atmospheres the explosive p.d. varies in a linear manner with the pressure; (ii.) at high pressures the ratio of p.d. to pressure diminishes; (iii.) in the case of nitrogen the curve of p.d. shows a maximum in the neighbourhood of the point of maximum compressibility; (iv.) with oxygen and hydrogen the pressures were not sufficiently great to reach the point of maximum *pv*; (v.) with $CO_2$ at the critical point there seems to be a diminution of the explosive p.d.; the phenomenon is complex owing to the partial decomposition of the gas produced by the spark; (vi. experiments made in the presence of a radium salt or with Röntgen rays give results not differing sensibly from the above. S. G. S.

**1465.** *Dynamics and Hysteresis of the Electric Arc.* **H. T. Simon.** (Phys. Zeitschr. 6. pp. 297–319, May 15, 1905. Phys. Inst. d. Univ., Göttingen, April, 1905.)—Throughout the paper the relation between e.m.f. and current is exhibited in the form of a characteristic in the manner indicated by Kaufmann [see Abstract No. 1672 (1900)]. The general conditions for equilibrium of the current are discussed with reference to this characteristic, and several problems, such as the stability of the current in the Nernst filament and the instability of the current in certain cases of the discharge through gases, are given. The author gives the name static characteristic to the curve connecting *e* and *i* when the determinations are made step by step, the conditions at each step being steady, and the name dynamic characteristic to that obtained when the conditions are varying, as in the case of the alternating-current arc. The methods adopted for finding the latter are described. In some cases the oscillograph is used, and the consecutive valves of *e* and *i* measured upon the curves and afterwards plotted, and in others a Braun tube is employed, the e.m.f. causing a displacement by electrostatic means, and the current, a displacement at right angles to this by electromagnetic means, the characteristic being thus directly determined. The dynamic characteristic of the alternating arc bears a resemblance to the cyclic curve of magnetisation, and the author pursues the analogy between the arc circuit and a magnetic circuit with small air-gap. The influence on the characteristic of length of arc, resistance of circuit, and periodicity are examined, and diagrams are given. It is next shown, from the theory of the arc, that the product (FT) of area and absolute temperature of the crater, determines the e.m.f. necessary to produce a given current. The temperature is maintained by the heat (*ei*) developed by the current, and the loss is WFT, which equals *ei*, W being a constant which varies with varying conditions. Taking FT as corresponding to a definite resistance of the arc, characteristics are derived from corresponding values of *ei* and FT, using different values for the constant W. It is shown that when heat is supplied from some outside source, the characteristic is lowered, *i.e.*, a smaller e.m.f. is required to produce a given current. The author obtains equations for the rise and fall of the current in terms of the e.m.f., the product FT, W, density, specific heat, and conductivity of the electrodes, and shows why the arc ceases so quickly when metallic electrodes are employed. Curves are constructed, various constants for the electrodes being used. An explanation of the oscillatory current in the Duddell circuit is also given. S. G. S.

**1466.** *Direct Determination of Damping of Electrical Oscillations.* **F. Piola.** (Elettricista, Rome, 4. pp. 145–148, May 15, 1905.)—Owing to the difficulty of calculating the damping of the oscillations in a given circuit, which is due to the variation in permeability, direct experimental determination is desirable. The method employed is a modification of that used by Rutherford and by Miss Brooks [see Abstract No. 2401 (1901)]. The effect of a rapidly oscillating field on an iron wire which is under the influence of a slowly varying field depends upon whether the direction of the first half oscillation coincides with or is in the opposite direction to the original field, and also upon the damping of the superimposed field. If a second oscillation is employed, of the same decrement as the first, and whose first half oscillation coincides in direction and amplitude with the second half oscillation of the first vibration, then the two will produce exactly the same effects on the residual magnetism of the iron wire. The author determines the e.m.f.'s required to produce the two oscillations, so that when they are in opposite directions they produce equal effects on the residual magnetisation. The ratio of the e.m.f.'s is the decrement required. A short description of the method of carrying this out, and of the results obtained, is given. S. G. S.

## ELECTRICAL PROPERTIES AND INSTRUMENTS.

**1467.** *Absolute Value of the E.M.F. of the Clark and the Weston Cells.* **H. S. Carhart** and **G. W. Patterson.** (Inst. Elect. Engin., Journ. 34. pp. 185–189, Feb., 1905.)—The method used relies on the measurement by an absolute electrodynamometer [see Abstract No. 1284 (1905)] of a current through a known resistance, the resulting potential difference being compared by the potentiometer method with the e.m.f. of the cell under investigation. The resistance coils employed had been verified at the Reichsanstalt, and were assumed to have remained constant. The coils of the electrodynamometer were wound on plaster-of-Paris cylinders and the dimensions of the smaller coil are stated to be 0·01 per cent. approximately. This smaller coil was suspended by a wire whose torque balanced the torque between the coils when the current to be measured was passing, mirrors at both ends of the suspension enabling the twist to be determined to 1/250,000 of a turn. The real difficulty in the measurements lay in the wire, for elastic fatigue and sub-permanent set caused much trouble, and at the time when the paper was read satisfactory results had not been obtained. Plaster-of-Paris cylinders were employed to hold the coils, preliminary experiments having indicated that it was superior to wood, vulcanite, and porcelain, the magnetic permeability of plaster-of-Paris differing from unity by not more than 1 part in 40,000. When the effect of elastic fatigue in the suspension wire has been reduced, it is hoped to reach results accurate to at least 1 part in 5,000. For the present the authors are only prepared to say that the legalised value of the e.m.f. of the Clark cell is too high. [See also Abstract No. 489B (1904).] F. E. S.

1468. *Influence of Röntgen Rays on Lead Accumulators.* **F. E. Carcano.** (Elettricista, Rome, 4. pp. 33–34, Feb. 1, 1905.)—From preliminary experiments on the effect of Röntgen rays on an accumulator of the Planté type, it is concluded that: (1) if the lead plates intended as poles of an accumulator are first exposed to the action of the rays, an element is obtained which, at least in the period of initial formation, exhibits a capacity smaller than that of a normal accumulator of the same size and under similar conditions; (2) the formation of an element with ordinary plates already immersed in the electrolyte, is arrested by the rays; (3) the effect of the rays does not sensibly alter the aspect of the plates in the charging, but is revealed in the successive discharge; (4) sometimes the characteristic difference of plates subjected to the rays is only noticeable after several charges and discharges, and (5) both positive and negative plates undergo change, though it is perhaps more energetic with the latter. W. H. Si.

1469. *Relation between Surface Tension and Potential Difference.* **C. Christiansen.** (Ann. d. Physik, 16. 2. pp. 382–397, Feb. 24, 1905.)—Gouy has shown that there is no general curve connecting capillary constant and potential difference. This has been contested, and the author's experiments are in accord with those of Gouy. To obtain consistent readings with the capillary electrometer the liquid should contain some dissolved salt of mercury. The variation of the amount of salt, although almost without effect on the maximum difference of level, has a large effect on the position of the Lippmann curve, this being shown by impressing an external e.m.f. of from 0 to 1·6 volts on the instrument and measuring the difference of level with various strengths of mercury salt in the liquid. Other experiments lead to the result that the surface tension for a given p.d. is, for the same electrolyte and mercury or amalgam, independent of the manner in which the p.d. is produced, and the author considers that they confirm Gouy's law, viz., that the surface tension between a given electrolyte and different (dilute) amalgams only depends on the potential difference; the nature of the metal contained in the mercury does not come into question. G. E. A.

1470. *Thomson Effect in Soft Iron.* **E. H. Hall, Churchill, Campbell, and Serviss.** (Amer. Acad., Proc. 41. 2. pp. 23–55, May, 1905.)—Through two similar cylindrical bars of iron, $\alpha$ and $\beta$, with their ends at different temperatures, the same current passed, flowing from the hot end to the cold end of $\alpha$ and from cold to hot in $\beta$. The temperature gradients differed owing to the Thomson effect, and the distribution of temperature was studied with the aid of thermal couples. Let a length L cm. of each bar be considered, and let the area of cross-section be S. Then, if the specific electric resistance of the iron be assumed to be a linear function of the temperature, we have $K(1+\gamma t_a)L/S$ as the resistance of the L cm. of $a$, and $K(1+\gamma t_b)L/S$ as the resistance of the L cm. of $\beta$, K being the specific resistance at 0° C., $\gamma$ the temperature coefficient of resistance, $t_a$ the mean temperature of the L cm. of $a$, and $t_b$ the corresponding temperature of $\beta$. Let the specific thermal conductivities of the iron be $k_{a_1}$ at the temperature $t_{a_1}$, $k_{a_2}$ at the temperature $t_{a_2}$, &c.; also let $q_a$ be the "Thomson effect heat" in $a_1a_2$, $q_b$ the similar quantity in $b_1b_2$, and $g$ be the temperature gradient at any point in either bar, with a subscript approximate to the point. Then it is shown that $q=(q_a+q_b)/2=\frac{1}{2}S[(k_{a_1}g_{a_1}-k_{b_1}g_{b_1})+(k_{b_2}g_{b_2}-k_{a_2}g_{a_2})]-0{\cdot}1194i^2K\gamma(t_a-t_b)L/S$, $i$ being the current strength. The difference of temperature between any part of $\alpha$ and the corresponding part of $\beta$ was always less than 1° C.; in consequence, $k_{a_1}$ was practically equal to $k_{b_1}$, and $k_{b_2}$ equal to $k_{a_2}$, in the preceding equation. Of these quantities S, L, K, $i$, and $\gamma$ were easily measured, and $k_{a_1}$, &c., were found from previous experiments on thermal conductivity. The differences of gradient and the differences of temperature at corresponding parts of the two bars were the difficult things to determine. With the apparatus employed the value of $q$ found was 0·00478, and the mean amount of heat produced per sec. by sending 10 amps. through a temperature interval of 1° C., downward, in the region between 13° C. and 90° C. was calculated to be $-0{\cdot}0000246$ unit. Assuming that the heat generated or absorbed per sec. by a given current is proportional to the absolute temperature of the metal at the point considered, the Thomson coefficient is $-0{\cdot}0000246/[273+\frac{1}{2}(90+13)]=-757\times10^{-10}$. F. E. S.

**1471.** *Insulating Effect of Copper Oxide.* **P. Harckman.** (Soc. Belge Élect., Bull. 22. pp. 341–347, May, 1905.)—The fact that a copper wire, one part of which is coated with oxide, will conduct readily when the current flows from the clean to the oxidised end, but with difficulty in the reverse direction [see Abstract No. 1645 (1902)], is explained on the ionic theory of de Heen. A short sketch of this theory is given [see "Prodrome de la théorie mécanique de l'electricité," by de Heen]. The ion is supposed to consist of a gyrostatic element, which draws in ether at one end and expels it at the other. As one ion approaches another it tends to neutralise it, and ordinary conduction is produced by the travelling backwards and forwards of these ions in the electrical field, the free ions on the electrodes being neutralised. The layer of copper oxide is supposed to play a part in carrying the current; the ions in the copper will easily neutralise those of the oxide when travelling in one direction, but not when travelling in the opposite direction. S. G. S.

**1472.** *Electrolytic Preparation of very Fine Wires.* **H. Abraham.** (Comptes Rendus, 140. pp. 1444–1445, May 29, 1905.)—A wire is taken as the anode of an electrolytic bath; its resistance is measured from time to time, and the current stopped when the cross-section of the wire has been reduced to the desired value. The bath is made very dilute, and currents of the order of 0·01 amp. per sq. cm. are employed. G. E. A.

**1473.** *Measurement of Frequency of Alternating Currents.* **L. Dall'Oppio.** (Elettricista, Rome, 4. pp. 161–162, June 1, 1905.)—The method of finding the frequency of alternation of a current by determining the note emitted by a wire carrying the current and situated in a strong magnetic field, as employed by Scarpa, is discussed. In the author's modification of the arrangement the wire is loaded gradually until maximum and steady vibration occurs, and a tracing on a moving smoked plate is obtained by means of a style. A parallel tracing for a standard fork is obtained simultaneously, and the frequency of the wire, and hence of the alternating current, is deduced. The accuracy of the method is verified by the electrochemical tracing method of Sartori and by a stroboscopic method, using the light from an arc maintained by the current to illuminate a rotating disc. The agreement between the methods was found to be satisfactory. S. G. S.

1474. *Electrometer with Sextants and Neutral Needle.* **Guinchant.** (Comptes Rendus, 140. pp. 851-852, March 27, 1905.)—In the endeavour to eliminate the difficulties found with the usual quadrant electrometer (the chief of which are charging the needle, while preserving considerable mobility and fixity of zero), the author has devised a modified form of instrument in which the quadrantal sectors are replaced by sextants. Of these, the central pair cover an angle of about 80°, the side sectors being slightly smaller. The needle is placed under the sectors, and is formed of a silvered plate of mica made rigid by cross strips of mica. It covers the whole of the central sectors and about a third of the lateral sectors. The theory is identical with that of the quadrant forms. In a model made by the author he obtained a deflection of 310 mm. for one volt on a scale at 1 m. distance, using a pile of 200 elements. To provide the requisite directive couple a small steel magnet is used. The distance of needle from plane of sectors was about 2·5 mm. C. P. B.

## REFERENCES.

1475. *Relation between Gravitation Constant and Charge on the Electron.* **E. v. Schweidler.** (Phys. Zeitschr. 6. p. 237, April 15, 1905.)—The conclusion of Davis [see Abstract No. 598 (1905)], that "the value of the gravitation constant, taking the unit of mass as the amount of matter associated with the unit of electricity in the ion, is the inverse square (?) of the velocity of light," is criticised on the ground that quantities differing in dimensions have been compared. The author gives the dimensions in order to show that the quantities compared are of an essentially different kind, and states that the agreement would not have been found had any other than the c.g.s. system of units been employed. A similar conclusion of V. Fischer (Phys. Zeitschr. 6. pp. 106-107, 1905) is also criticised. S. G. S

1476. *Rotation of an Electron with Volume Charge.* **A. H. Bucherer.** (Phys. Zeitschr. 6. pp. 269-270, May 1, 1905.)—A previous paper by the author dealt with the rotation of an electron with a surface charge [see Abstract No. 1261 (1905)]. The present one deals similarly with the case of a volume charge, and obtains expressions for the magnetic field and electric displacement. E. H. B.

1477. *Virial for Electron Atoms, Characteristic Equation and Joule-Kelvin Effect.* **H. Nagaoka.** (Mathematical and Physical Soc., Tokyo, 2. 21. pp. 335-340, 1905.)—Starting with the virial equation given by Clausius, van der Waals' characteristic equation is obtained, whence an expression is deduced identical in form with that of Rose-Innes, but having constants discrepant with his. The bearing of this on the Joule-Kelvin effect is also discussed, but the questions at issue are left open pending experimental tests of the validity of the final equation. E. H. B.

1478. *Electrodeless Discharge.* **B. Davis.** (Phys. Rev. 20. pp. 129-160, March, 1905.)—This paper has already appeared in abstract [see Abstract No. 352 (1904)]. R. S. W.

1479. *Dynamics of Electrons.* **H. Poincaré.** (Comptes Rendus, 140. pp. 1504–1508, June 5, 1905.)—The negative results of the Michelson-Morley aberration experiments were explained by Lorentz on the hypothesis that translation of matter involves a change in its dimensions. The present author arrives at the same results in all the general features of the problem, but has modified and completed it in some details. E. H. B.

1480. *Earth-currents: Proposed Method for their Investigation.* **J. E. Burbank.** (Terrestrial Magnetism, 10. pp. 23–49, March, 1905.)—The author has made an exhaustive study of the literature on the subject. He gives a list of the literature and a summary of the chief observations. As most of the questions, *i.e.*, influence of the sun, weather, soil, earth-plates, magnetic storms, atmospheric electricity, &c., remain open, he suggests a method for further work. Continuous photographic records and simultaneous observations of atmospheric electricity will be needed. H. B.

1481. *Light-electric Effects at the Surface of Electrolytes.* **C. Schaefer.** (Phys. Zeitschr. 6. pp. 265–267, May 1, 1905. Phys. Inst. d. Univ., Breslau, April, 1905.)—Bose has shown [see Abstract No. 947 (1903)] that electrolytes emit negative electricity when exposed to kathode rays. The author thought that ultra-violet light should also cause this emission. The results of the experiments are entirely negative. This may be due to the non-existence of electrons in the liquid, the electric charge always being associated with matter. R. S. W.

1482. *Conductivity of the Gases proceeding from Flames.* **E. Bloch.** (Comptes Rendus, 140. pp. 1327–1329, May 15, 1905.)—From a measurement of the saturation curve for a space through which the gases proceeding from a small gas flame are drawn, it is inferred that the ions contained in the gases assume, after a time, a mobility of the order of 0·01 mm. They should therefore be classed with the large ions. [See also Abstracts Nos. 163 and 581 (1905).] G. E. A.

1483. *Applications of Braun Tube.* **W. M. Varley** and **W. H. F. Murdoch.** (Electrician, 55. pp. 335–336, June 16, 1905.)—An account of the experimental arrangements used by the authors for exhibiting phase difference, hysteresis, oscillatory condenser discharge, &c., by means of the Braun kathode-ray tube. A. H.

1484. *Antennæ in Wireless Telegraphy.* **F. Lefèvre.** (Assoc. Ing. Él. Liége, Bull. 5. pp. 129–135, Feb., 1905.)—A mathematical paper dealing with the part played by the antennæ, and especially as to the value of their inductance. E. H. B.

1485. *Inductance of a Straight Wire.* **G. Sobrini.** (Assoc. Ing. Él. Liége, Bull. 5. pp. 135–138, Feb., 1905.)—Discusses the applicability of certain formulæ to the case of antennæ in wireless telegraphy. E. H. B.

1486. *Simple Variable Condenser for Tuning Experiments.* **J. J. C. Müller.** (Phys. Zeitschr. 6. pp. 231–232, April 15, 1905.)—The condenser used in the Dönitz wave-meter is difficult to construct with simple means. An easily made variable condenser is described, using which the author has been able to make a satisfactory wave-meter [see Abstract No. 210B (1904)] for experimental work.

1487. *Contact Electricity of Alloys.* **N. A. Hesehus.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 35–37, 1905.)—The author, in conjunction with N. Georgiewsky, finds that alloys which, like Wood's metal (50 per cent. Zn + 50 per cent. Pb) and Lipowitz's alloy (90 per cent. Zn + 10 per cent. Sb), have melting-points below those of the constituent metals take places in Volta's electromotive series nearer to the positive end than they should do according to their quantitative composition. D. H. J.

## CHEMICAL PHYSICS AND ELECTRO-CHEMISTRY.

**1488.** *A Relationship in Chemical Dynamics.* **J. Plotnikow.** (Zeitschr. Phys. Chem. 51. pp. 603–608, April 25, 1905. Phys. Chem. Inst., Leipzig, Jan. 22, 1905.)—It is commonly known that as the temperature rises in arithmetical progression the velocity-constant $k$ of a reaction increases in geometrical progression, so that $\log k = \alpha t + \beta$, where $t$ = temperature and $\alpha$ and $\beta$ are constants. The author has apparently re-discovered this relationship, which he tests by numerous examples. In general it may be said that the logarithmic relationship gives a good approximation. In some cases the agreement is very close. F. G. D.

**1489.** *Absence of Helium from Carnotite.* **E. P. Adams.** (Amer. Journ. Sci. 19. pp. 321–322, April, 1905.)—Carnotite promises to become an important source of radium; specimens have been found which have a radio-activity 1·6 times that of metallic uranium. On heating in vacuo several gm. of this carnotite, considerable quantities of carbon dioxide and water were driven off, and when these were absorbed by caustic potash and phosphorus pentoxide respectively, only the nitrogen spectrum could be observed when an electric discharge was sent through a vacuum tube connected to the pump; no difficulty was found in obtaining the helium spectrum when only a tenth as much pitchblende, monazite sand, or thorianite was used. A similar experiment with 300 gm. of activity 0·8 also gave a negative result. The absence of the gas is explained as being due to the permeability of the mineral, which, unlike pitchblende, is so porous as readily to permit of diffusion. [Compare Travers, Abstract No. 1089 (1905).] T. M. L.

**1490.** *Effect of Ultra-violet Light on Glass.* **F. Fischer.** (Phys. Zeitschr. 6. pp. 216–217, April 1, 1905. From the I. Chem. Inst. d. Univ., Berlin. Chem. News, 91. pp. 192–193, April 28, 1905.)—The glasses tested are placed near a mercury vapour lamp in a quartz bulb. Of eight sorts of glass exposed to the radiation, four remained unchanged; the others were coloured violet within twelve hours, the colouring being noticeable in some cases in fifteen minutes. The affected glasses, viz., ordinary Thüringer glass, apparatus glass from two sources, and Jena normal thermometer glass, were all found to contain manganese. The unaffected glasses, viz., Jena combustion tube, Durax glass, and German and English lead glass, were free from this metal. The colour disappears if the glass is heated to softness, and reappears again on further exposure to the radiation. [See also Abstract No. 1103 (1905).] G. E. A.

**1491.** *Permeability of Quartz and of Glass.* **Berthelot.** (Comptes Rendus, 140. pp. 1159–1162, May 1, and pp. 1286–1292, May 15, 1905.)—On account of the interest attaching to the passage of gases through the sides of heated quartz tubes, further experiments have been made [see Abstract No. 1100 (1905)]. The transpiration of hydrogen was found to be very evident at 1,300°. Using air at 1,400°, it was ascertained that the transpiration of the oxygen was notably greater than that of the nitrogen. The experiments on quartz vessels [Abstract No. 1100 (1905)] have led the author to examine, in this later paper, the permeability of glass, which is really an amorphous silicate susceptible of softening (like quartz) at a certain temperature. When kept for a long period at a temperature a little below the fusing point, it becomes opaque and devitrifies. Quartz behaves in a like manner when heated in the oxy-acetylene blow-pipe. Whatever be the nature of these changes, they are little evident during the limited duration of time sufficient to manifest the permeability of quartz. Trials have been made with two kinds of glass: (1) *verre blanc*, which softens at 550°, and becomes very plastic at 650°; (2) *verre d'Iéna*, which softens about 700°—750°. The method of experiment was as previously described. The results show that these glasses behave like quartz, and are permeable to gas when they are maintained at a temperature sufficient to soften them. By osmotic action glass tubes exchange through their walls the gas they contain with the atmospheric gases. These results may be of great importance in all cases where heated glass is employed, as in organic analyses, the reduction of metals by hydrogen, the measurement of high temperatures by the gas thermometer, the determination of atomic weights, and in similar cases. W. W. H. G.

1492. *Osmose through Quartz Tubes.* **G. Belloc.** (Comptes Rendus, 140. pp. 1253–1254, May 8, 1905.)—In the course of an investigation on the gases occluded in steel, it has been found that porcelain tubes allow air to enter under 1,000°. An attempt has been made to utilise quartz tubes for the purpose. The first trials have been successful, but after a certain number of successive heatings the analysis of the extracted gas revealed the presence of $CO_2$ and $H_2O$, due to the osmose of oxygen, which commenced at 600°. The tube became a milky colour. On a microscopical examination being made a crystalline formation was noticed. This agrees with the observations of other experimenters. W. W. H. G.

1493. *Electrically-heated Carbon-tube Furnaces.* **R. S. Hutton** and **W. H. Patterson.** (Faraday Soc., Trans. 1. pp. 187–195; Discussion pp. 195–196, May, 1905. Electrician, 54. pp. 1000–1002, April 7, 1905. Abstract. Électricien, 29. pp. 365–366, June 10, 1905.)—The authors describe the means they have adopted to obtain electrically-heated carbon-tube furnaces, into which various substances can be introduced in boats or crucibles and heated in an atmosphere of such gas as may be required. The main points to which they had to turn their attention were: (1) Quality of carbon; (2) insulating material; (3) connections to the copper leads; (4) permeability of the carbon tube to gases. They find that agglomerated carbon tubes of good quality can be used as well as graphite, which had to be bored from solid rods. Powdered carborundum is the best insulating material. Water-cooled copper leads, soldered to the tube after the carbon had been coated electrically with copper, were used. An outer tube with a gas space, into which was introduced a gas similar to that inside the inner tube, the whole being insulated as before, was adopted. The paper gives a number of figures showing current employed and heat obtained in different-sized tubes, and dimensions and sketches are given of the various tubes employed. J. L. F. V.

1494. *Production of Diamonds in the Electric Furnace.* **H. W. Fisher.** (Elect. World and Engineer, 45. pp. 844–845, May 6, 1905. Paper read before the Pittsburg Academy of Sciences and Arts, April 6, 1905.)—Not finding Moissan's furnaces suitable, the author used a furnace built up of firebricks, with a magnetite lining, asbestos, graphite electrodes with brass castings, and a crucible of Acheson graphite. The whole crucible, with its charge of about 2 lbs., could be dropped from the furnace directly into 2 ft. of water. Diamonds up to 0·5 mm. in dimensions were found only in the small portions of the matrix which had separated from the big lump, and therefore been cooled very rapidly; they showed a tendency to fog photographic plates. The temperature of the matrix, whose composition is not stated, was probably between 2,500 and 2,800° C. H. B.

**1495.** *Action of Carbon Monoxide on Ammonia.* **H. Jackson** and **D. Northall-Laurie.** (Chem. Soc., Journ. 87. pp. 433–434, April, 1905.)—When a mixture of dry carbon monoxide and ammonia is heated in presence of platinum, subjected to the silent electrical discharge, to electric sparking, or treated with the high frequency current, combination occurs and ammonium cyanate is formed, which, as the temperature rises, is rapidly converted into carbonide. The action is probably that represented by the equation $CO + 2NH_3 = NH_4.CNO + H_2$, water and methane being subsequently produced by the interaction of the hydrogen with carbon monoxide. T. M. L.

**1496.** *Internal Friction of Binary Mixtures of Hydrogen, Oxygen, and Nitrogen.* **F. Kleint.** (Deutsch. Phys. Gesell., Verh. 7. 7. pp. 146–158, April 15, 1905. Phys. Inst., Halle a. S.)—The author's investigations of these mixtures show that small admixtures of oxygen and nitrogen considerably increase the coefficient of friction of hydrogen, whilst the latter influences the friction coefficients of oxygen and nitrogen to a less extent—in the case of oxygen by about 5 per cent. The frictional coefficients of the mixtures examined from 0° to 183° can be very well expressed by Sutherland's formula, viz., $\eta_\vartheta = \eta_0 [(1 + \alpha C)/(1+C/\theta)] \sqrt{1 + \alpha\vartheta}$. The cohesion constants of the mixtures can be calculated approximately from those of the pure constituents by the law of mixtures. The formula given in 1879 by Puluj must be regarded as approximate, and shows the greatest concordance where the frictional coefficients do not vary widely from one another, *i.e.*, with oxygen-nitrogen mixtures. Thiesen's formula [see Abstract No. 615 (1903)] corresponds very closely with the observed values, which hence confirm Thiesen's theory. The quotient $A = a_{12}/a_{11}$ appears to vary but little as the temperature rises, whilst $B = a_{21}/a_{22}$ changes considerably. The case of nitrogen-oxygen at 100° is an exception to this rule, probably owing to the small difference between the friction coefficients. The condition which Thiesen showed must be fulfilled in order that the diffusion coefficient may be constant ($a_{11} = a_{12} = a_{21} = a_{22}$) does not hold, so that this coefficient must be expected to vary. T. H. P.

**1497.** *General Relations between the Heats of Combustion of Organic Compounds and their Constitutional Formulæ. Calculation of Heats of Combustion.* **P. Lemoult.** (Annal. Chim. Phys. 5. pp. 5–70, May, 1905.)—The author establishes a method of calculating the heats of combustion of organic compounds taking account of the different elementary groups, such as, $C - C$, $C_2 = C_2$, $C_3 \equiv C_3$, $C - H$, $C - N$, $N - H$, &c., and of the oxygenated, nitrogenated, and halogenated functional groups. This method is often not so practical as the one previously given [see Abstract No. 2941 (1904)]. In the groups $C - C$, $C - H$, $C - N$, $C = N$, $C \equiv N$, $C - S$, and $S - H$, there exists thermal independence, that is, their influence on the heat of combustion depends only on those of the atoms they contain, the values being : 102 cal. per 12 gm. C. ; 27·5 cal. per gm. H ; 16·5 cal. per 14 gm. N., and 151 cal. per 32 gm. S. On the other hand, among the atoms of the groups, $C = C$, $C \equiv C$, $N - H$, and $C_2 = S$, there is thermal dependence, and the thermal value of the linking is given for each of these groups. From these considerations the author deduces the heats of formation of the molecules of some of the elements, starting from their respective atoms in the state of thermal isolation they possess in organic compounds. For the non-combustible elements, N, Cl, Br, these heats of formation are positive and diminish with their resistance to combustion, whilst for the combustible elements, C, H, S, I, they are negative. The compounds of the purine group are remarkable in that, compared with normal compounds, they exhibit a deficit of energy of 26 cal. For compounds possessing multiple functions, the measured heats of combustion are less than the calculated values. [See also Abstracts Nos. 2940 and 2942 (1904).] T. H. P.

**1498.** *Relative Value of the Calorimetric Methods for determining Heats of Combustion of Volatile Organic Compounds.* **J. Thomsen.** (Zeitschr. Phys. Chem. 51. pp. 657–672, May 9, 1905.)—The author shows that the method of normal combustion used by him to obtain the data given in Vols. II. and IV. of his "Thermochemische Untersuchungen" leads to results which are found to be in agreement among themselves when the values for the separate members of a homologous group are compared with one another, and also when the values for different groups are compared. These data hence possess a high relative accuracy, and can be used for determining the relations between heats of combustion and constitution of organic compounds. The data which are given by Berthelot in his "Thermochimie II.," for the hydrocarbons and the corresponding halogen compounds, and which have in almost all cases been obtained by the explosion method (calorimetric bomb), show, on the other hand, great irregularities. T. H. P.

**1499.** *Conductivity of Colloidal Hydroxide of Iron.* **A. V. Dumansky.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 213–220, 1905.)—The author studies the question of the ammonium chloride always present in colloidal ferric hydroxide prepared by Graham's method. On determining the electrical conductivity of solutions containing, firstly, one and the same fixed amount of colloid but varying amounts of ammonium chloride, secondly, a fixed amount of ammonium chloride but varying amounts of colloid, it was found that the effect of the colloid is always to diminish the conductivity of the ammonium chloride solution. This diminution of conductivity may be interpreted on the supposition that the ammonium chloride, is divided between the two solvents, viz., water and the colloid particles. [See also Abstract No. 624 (1905).] D. H. J.

**1500.** *Constitution of Organic Salts of Nickel and Cobalt in Aqueous Solution.* **O. F. Tower.** (Amer. Chem. Soc., Journ. 27. pp. 386–391, April, 1905.)—The paper gives the results of conductivity and freezing-point determinations of the nickel, cobalt, and magnesium salts of glutaric, and hydroxyglutaric and trihydroxyglutaric acids. The trihydroxyglutarates yield somewhat higher apparent molecular weights and molecular conductivities than the other glutarates, so that, if there is any tendency towards polymerisation of these salts, it is strongest when the maximum number of hydroxyl groups are present in the molecule. T. H. P.

1501. *Hydrofluoric Acid.* **E. Deussen.** (Zeitschr. Anorg. Chem. 44. 3. pp. 300–340, March 24, and 4. pp. 408–430, April 4, 1905. Inst. von E. Beckmann, Laborat. f. angew. Chemie d. Univ., Leipzig.)—The activity of the hydrogen ions of hydrofluoric acid in aqueous solution can be determined by the inversion method. The results show that this acid must be regarded as a feeble acid, and not, as is generally stated, as a strong one. In concentrated solutions the acid is somewhat stronger than monochloroacetic acid, while with a dilution of 1 gm.-mol. in 4 litres the two acids are dissociated to the same extent; with greater dilutions the dissociation increases more slowly than that of monochloroacetic acid; with 1 gm.-mol. in 1,000 litres, the former acid is half dissociated. Hydrofluoric acid exhibits an exact parallelism between its inversion velocity and its conductivity. It is neither markedly monobasic nor markedly dibasic. The rotation of solutions containing it can be measured directly, but it is best to use fluorspar plates for the polarimeter tube instead of glass; in carrying out inversion experiments at high temperatures with this acid, a tube of platinum, fluorspar or oxide-free copper should be employed, but it must be remembered that at high temperatures platinum has a slight inverting action on sugar solutions. An aqueous *n*-solution of commercial ammonium fluoride contains a negligible number of hydrogen ions at 25°C. T. H. P.

1502. *Equilibrium between Iodic Acid, Hydriodic Acid, Iodine, and Water, and between the analogous Bromine Compounds.* **R. Luther** and **G. V. Sammet.** (Zeitschr. Elektrochem. 11. pp. 293–295, May 19, 1905. Phys-chem. Inst., Leipzig, April, 1905.)—The authors determine the equilibrium between the iodine compounds $HIO_3 + 5\,HI \rightleftarrows 3I_2 + 3H_2O$, both by chemical and electric potential methods; in the case of the bromine compounds the chemical method failed. The reaction $I_2 + H_2O \rightleftarrows I' + H^{\cdot} + HIO$ is also studied, and the solubility determinations of I, AgI, and $AgIO_3$, further conductivity measurements of $HIO_3$ and of $NaIO_3$, enable the authors to give thermal data; the formation of iodine from iodate and iodide corresponds to + 642 or 683 large calories (two methods). The paper is a brief summary, under nineteen headings, of the results of researches, details of which are soon to be published. H. B.

1503. *Calcium Sulphate in Ammonium Sulphate Solution.* **E. C. Sullivan.** (Amer. Chem. Soc., Journ. 27. pp. 529–539, May, 1905. From the U.S. Geological Survey.)—At 25° calcium sulphate is two-thirds as soluble in dilute (0·1 gm.-mol. per litre), and twice as soluble in concentrated (3 gm.-mols. per litre) ammonium sulphate solution as in water. The specific electrical conductivity of concentrated ammonium sulphate solutions is diminished by saturation with calcium sulphate. Assuming that dissociation of ammonium sulphate takes place into $2NH^{\cdot}$ and $SO_4''$, and of calcium sulphate into $Ca^{\cdot\cdot}$ and $SO_4''$ only, and that the conductivity is a measure of such dissociation, the solubility of calcium sulphate in dilute ammonium sulphate solutions is greater than is required by the mass law. The conductivity of the dilute mixtures may be accurately calculated by means of Arrhenius' principle of isohydric solutions. The data thus obtained show that the concentration of non-dissociated calcium sulphate decreases with increase of the amount of the ammonium sulphate. The results as a whole confirm the fact that all the factors necessary for reconciling the mass law to the behaviour of electrolytes are not yet known. T. H. P.

**1504.** *Gold-Lead Alloys.* **R. Vogel.** (Zeitschr. Anorg. Chem. 45. 1. pp. 11–23, April 27, 1905. Communication from the Inst. f. anorgan. Chemie der Univ., Göttingen.)—The melting-point diagram of gold-lead alloys evidences the existence of two compounds, $AuPb_2$ and $Au_2Pb$. The first of these is harder than lead, moderately brittle, and crystallises in silvery-white needles with rounded edges. $Au_2Pb$ separates on slow cooling in large white crystals which probably belong to the rhombic system and are easy to distinguish from the needles of $AuPb_2$. $Au_2Pb$ is even more brittle than $AuPb_2$, and has a formula analogous to that of aurous oxide, $Au_2O$. The compound $Au_2Pb_3$, the formation of which was indicated by Maey's measurements on specific volumes [see Abstract No. 99 (1902)], is shown by the author's results not to exist. Microphotographs of sections of alloys of lead and gold of various compositions are given. T. H. P.

**1505.** *Alloys of Copper and Bismuth.* **A. H. Hiorns.** (Faraday Soc., Trans. 1. pp. 179–185; Discussion, pp. 185–186, May, 1905. Page's Weekly, 6. pp. 731–735, April 7, 1905. Abstract.)—The author's experiments indicated the existence of eutectics at 245°, 858°, and 1020° C. (97·2, 57, and 2 per cent. Bi respectively). The latter was not observed by Gautier, nor by Heycock and Neville. It is possible that $Cu_3Bi_2$ and $Cu_2Bi$ may be formed, but can only exist in contact with solutions containing excess of Bi. It has been pointed out by Arnold that with low Bi percentages the alloys are very brittle, due to the occurrence of an inter-granular network rich in bismuth, this structure also explaining the falling off in electrical conductivity produced by the presence of small quantities of Bi in Cu. Above 98 per cent. Bi, the properties differ little from those of Bi. F. R.

**1506.** *Variation of Potential Difference at the Contact of Miscible Solutions of Electrolytes.* **M. Chanoz.** (Comptes Rendus, 140. pp. 1024–1026, April 10, 1905.)—The potential-difference phenomena between two miscible liquids, A and B, in direct contact are of two kinds. (1) When A is an aqueous solution of a pure non-hydrolysable electrolyte and B distilled water, the content of the electrolyte in the layers encountered in passing from A to B will regularly diminish to zero, so that the p.d. $V_A - V_B$ will be always the same, independently of the mode in which the contact is made. (2) If A and B are aqueous solutions of different pure bodies, or if A is pure water and B a solution of a mixture of two bodies, the potential difference will not necessarily be the same under all conditions of contact; the intermediate layers may, indeed, differ according as diffusion alone acts, or mixing be carried out at the zone of separation. In the symmetrical chain,

$$Zn \mid SO_4\,Zn \mid SO_4\,Na_2 \mid H_2O \mid SO_4\,Na_2 \mid SO_4\,Zn \mid Zn,$$

no difference of potential is observed if the two contacts between $Na_2SO_4$ and water are obtained by simple superposition, but as soon as flow takes place, the mobile $Na_2SO_4$ becomes negative. Experiment shows that (1) within certain limits the phenomenon is independent of the pressure, and is hence not comparable with Quincke's phenomena for the flow of water in tubes; and (2) the electric current developed follows Ohm's law, and is hence due to a true e.m.f., which, for the above solutions, reaches the value 56 millivolts. A further experiment, made with copper sulphate, shows that the observed phenomenon is connected with the existence of a sharp surface of separation created by the flow. The p.d. increases with the sharpness of the surface of separation to a maximum which is very near to the value observed when a stream of the solution flows into pure water. It is shown that the copper sulphate employed is slightly acid, and that the above phenomenon is due to the more rapid diffusion of the traces of sulphuric acid in the solution.

T. H. P.

1507. *Polarisation at a Metallic Anode.* **S. R. Milner.** (Phil. Mag. 9. pp. 645–668, May, 1905.)—According to Nernst, the current flowing through a voltameter will produce alterations either in the concentrations, at the surfaces of the two electrodes, of the metallic ions present in the solution, or in the concentration of the hydrogen and oxygen occluded in the two electrodes. In either case a concentration cell would be produced, whose opposing e.m.f. would constitute the polarisation. The author develops this theory mathematically, and tests it quantitatively with the aid of a silver voltameter. The silver anode A and kathode C are contained in different beakers, charged with nitric acid and connected by a siphon. The horizontal anode fits into a vertical glass tube, open above; a free electrode B, a large vertical silver plate, not joined to the pole, is suspended near it. The current will dissolve silver from the anode, and the silver ions will travel up the tube, while the concentration of the silver ions near B will hardly be changed. When silver nitrate is added to the kathode acid, the anode polarisation—alone dealt with in this communication—will be independent of the kathode polarisation. The former will be measured by the p.d. between A and B, and the author deduces formulæ for the polarisation by a constant current and by arbitrarily varied currents. He found difficulties in the exact determination of the resistance between A and B, and, while believing in the general correctness of his deductions, is inclined to distrust the close agreement between his formulæ and observations. He bases his calculations on the usually accepted value for $(RT/0{\cdot}4848\epsilon).10^{-8}=0{\cdot}0578$ volt, but points out that the actual determinations of the e.m.f. of silver nitrate concentration cells only yield 0·052 volt. On the other hand, the value assumed for the diffusion of the silver ions is probably too high, considering that nitric acid is present. These two errors would, to a certain extent, cancel one another. Experiments were also made with mercurous nitrate; four beakers were connected by siphons, containing nitric acid, and, further, the first the tubular mercury anode, the second the free mercury electrode, and the fourth the mercury kathode.

H. B.

1508. *Quantitative Electrolytic Precipitation of Copper.* **T. W. Richards** and **H. Bisbee.** (Amer. Chem. Soc., Journ. 26. pp. 530–536, May, 1904.)—The electrolytic precipitation of copper in a coherent film suitable for careful washing and accurate weighing requires the volume of the solution to be decreased, and the surface of deposition to be increased, as much as possible. This may be effected by spreading the concentrated solution in a thin film between two platinum electrodes. The authors make use of a pair of concentric platinum crucibles, or dishes, prevented from touching by a suitably-arranged glass rod, and the annular space between which contains the electrolyte. The current strength must be diminished as the deposition of copper proceeds; this can be done conveniently and automatically by using a storage cell of 1·9 volts as the source of the e.m.f.

T. H. P.

1509. *Electrolysis by Becquerel Rays.* **K. Schaum.** (Gesell. zur Beförd. d. ges. Naturwissensch. zu Marburg, Sitz. Ber. No. 4. pp. 42–48, 1904.)—A silver nitrate solution which is connected to earth and exposed to the β- and

$\gamma$-radiation from 1 mgm. of radium bromide becomes gradually covered with a skin, which, after nine hours, shines distinctly metallically and is found to consist of an aggregate of minute silver crystals. The separation is considered to be due to the discharging property of the negative electrons; the quantity is, however, so much greater than the amount which would result from electrolysis, that it is thought that besides the simple electrolysis there is also an electrolytic effect due to the gasions produced by collision of the ions. L. H. W.

1510. *Electrolytic Chromium.* **H. R. Carveth** and **B. E. Curry.** (Journ. Phys. Chem. 9. pp. 353–380, May, 1905.)—The continued investigation [see Abstract No. 1149 (1905)] shows that the previous researches of other workers are less contradictory than they appear to be. The free $CrO_3$ seems to exist and to be formed by anodic solution, when chromium passes from the divalent to the hexavalent condition. Metallic chromium can be deposited from chromic acid by currents of high density and high voltage, as Geuther stated in 1856, with whom the authors agree on many points; the metal may also be reduced in the laboratory from commercial chromic acid and from chromates after Placet and Bonnet. This electrolytic chromium may occlude as much as 250 times its volume of hydrogen. In the presence of mineral acids, chromates can be reduced to trivalent chromic salts; there are probably four oxidation stages, corresponding to chromium ions of four different valencies. H. B.

1511. *Electrolytic Oxidation of Organic Compounds.* (Zeitschr. Elektrochem. 11. p. 278, May 5, 1905.)—According to the patent of the Farbwerke, formerly Meister, Lucius, and Brüning, many organic compounds may be electrolytically oxidised in a bath containing cerium salts. The ceric compound formed at the anode is immediately reduced to cerous salt by the organic compound, so that the solution remains colourless. It is not necessary to use a diaphragm, and the compound to be oxidised may be either in solution or in suspension in a fine state of division. In this way naphthalene yields naphthaquinone and, when further oxidised, phthalic acid; phenanthrene gives phenanthraquinone or, on further oxidation, diphenic and benzoic acids (D. R.-P. 152063). T. H. P.

1512. *Electrolytic Separation of Iron and Zinc.* **E. G. Currie.** (Chem. News, 91. pp. 247–250, June 2, 1905.)—Trying modifications of the methods of Classen, Vortmann, and Hollard and Bertiaux [see Abstract No. 941 (1904)], the author finds that acetaldehyde and hydrazine sulphate do not answer as reducing agents in oxalate solutions. The addition of a little hydroxylanine sulphate to the solution of the sulphates of iron and zinc, and of ammonium oxalate is recommended. The electrolyte will, however, turn red and alkaline after about 30 min., and then tartaric acid has to be added, drop by drop, for more than three hours. The platinum kathode is previously silvered in a cyanide bath; the whole precipitate of silver, iron, and zinc must finally be dissolved in nitric acid, and the iron re-precipitated with ammonia, converted into oxalate and electrolysed; the zinc can then be determined by difference. H. B.

## REFERENCES.

1513. *Kinetics of Reversible Chemical Changes. Decomposition of* as-*Dimethylcarbamide.* **C. E. Fawsitt.** (Chem. Soc., Journ. 87. pp. 494–500, April, 1905.)

**1514.** *Future Developments in Physical Chemistry.* **W. D. Bancroft.** (Journ. Phys. Chem. 9. pp. 216–230, March, 1905. Address.)—Advance is recommended along the following lines: Reform (but not rejection) of the dissociation theory. Accurate study of concentrated solutions. Application of the phase law to alloys, cements, building materials, petrography, geology, geophysics, electrochemistry, organic chemistry, basic and double salts, and fractional crystallisation of rare earths. Study of irreversible reactions and the yields of reactions in organic chemistry. Application of the theorem of le Chatelier to a rational study of phosphorescence, fluorescence, chemi-luminescence, &c. Working out of a satisfactory theory of catalysis. Systematic study of possible methods for the transmutation of the elements, beginning with a thorough preliminary study of allotropic states. F. G. D.

**1515.** *Contributions to the Knowledge of the Polysulphides.* II. **F. W. Küster.** (Zeitschr. Anorg. Chem. 44. 4. pp. 431–452, April 4, 1905.)—The formation of polysulphides in solution is studied by means of potential measurements, the results being in accordance with Nernst's theory. [See also Abstract No. 1106 (1905).] F. G. D.

**1516.** *Application of Thermal Analysis (Equilibrium of Heterogeneous Systems) in Abnormal Cases.* **G. Tammann.** (Zeitschr. Anorg. Chem. 45. 1. pp. 24–30, April 27, 1905. Inst. für anorg. Chemie, Göttingen.)—In a former communication the author has shown how the composition of crystallised chemical compounds may be determined by the so-called thermal analysis, which is based on the cooling curves obtained. No difficulty is met with in applying this method of analysis [see Abstract No. 207 (1904)] if certain general conditions are fulfilled. These are stated. T. H. P.

**1517.** *Spectrographic Examination of some Thorium Preparations.* **G. Eberhard.** (Ber. Deut. Chem. Gesell. 38. pp. 826–828, Feb. 25, 1905. Chem. News, 91. p. 179, April 20, 1905.)—The author has found that no difference can be detected in the photographs of the spectra of various thorium preparations; as the presence of 0·5 per cent. of impurity can readily be detected in this way it would appear that no separation of the thorium into simpler components had taken place, as had been presupposed by Meyer and Drossbach. E. C. C. B.

**1518.** *Rotatory Power of Optically Active Substances.* **P. Walden.** (Zeitschr. Elektrochem. 10. pp. 957–958, Dec. 23, 1904. Ber. Deut. Chem. Gesell. 38. pp. 345–409, 1905.)—An important summary of the work that has been done, especially in recent years, on the optical rotation of liquids and solutions. T. M. L.

**1519.** *Specific Rotatory Power of Nicotine dissolved in Mixtures of Water and Alcohol.* **T. Gnesotto** and **G. Crestani.** (N. Cimento, 8. pp. 365–381, Nov., 1904. From Real. Istit. Veneto, Atti, 63. 2. April, 1904.)—The values for the specific rotatory power of nicotine in various mixtures of water and alcohol are in all cases inferior to those of the pure substance itself, assuming that each component of the mixture exercises on the active substance an influence proportional to the weight present. The difference between the specific rotation found and that calculated on the above hypothesis, starting from an all-alcoholic solution, at first increases rapidly with increase in the amount of water substituted for alcohol, soon reaches a maximum for a mixture containing about 80 per cent. alcohol, and then decreases almost proportionally to the amount of alcohol present. The densities and coefficients of contraction of the solutions, required for calculating the specific rotations, were determined in a special form of dilatometer, a description of which is given. W. H. Si.

**1520.** *Action of Inorganic Substances on the Optical Rotation of Levulose and Glucose.* **E. Rimbach** and **O. Weber.** (Zeitschr. Phys. Chem. 51. pp. 473–493, April 11, 1905. Chem. Inst. d. Univ., Bonn.)—The effect produced by the addition of inorganic substances to solutions of glucose and levulose was determined in a wide range of cases, but no important general conclusions could be drawn. It may be noticed that salts of As, Mo, and U, which produce very marked effects in the case of hydroxy-acids and sugar-alcohols, have no specially marked influence on the rotation of the sugars themselves. Sugar solutions containing zirconium salts exhibited fluorescence. T. M. L.

**1521.** *Optical Activity of Pennsylvania Naphtha.* **M. A. Rakusin.** (Jurn. Russk. Fisik. Chimičesk. Obščestva, 37. No. 2. pp. 221–223, 1905.)—The rotations, in a 50 mm. tube, of the naphtha and of various fractions are given. Native naphtha is distinguished from artificial petroleum by (1) optical activity, (2) the presence of particles of "molecular carbon." [See also Abstract No. 1085 (1905).] D. H. J.

**1522.** *The Rôle of Diffusion in the Catalysis of Hydrogen Peroxide.* **G. Senter.** (Roy. Soc., Proc. 74. pp. 566–574, April 10, 1905.)—The author supplements the discussion by Sand. [See Abstract No. 874 (1905).] A. F.

**1523.** *Electrochemical Series of the Metals.* **L. Kahlenberg.** (Internat. Elect. Congress, Trans. 2. pp. 53–65; Discussion, pp. 65–66, 1904. Amer. Electrochem. Soc., Trans. 6. pp. 53–65; Discussion, pp. 65–66, 1904. Zeitschr. Elektrochem. 11. pp. 385–386, June 16, 1905.)—A review of recent work in this region. T. H. P.

**1524.** *Formula for Osmotic Pressure in Concentrated Solutions where the Vapour follows the Gas Laws.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 781–787, May 11, 1905. Proc. 7. pp. 723–729, May 25, 1905.)—The author uses the thermodynamic potential for this case, solving the integrals in parts by the aid of Maxwell's rule. The formula obtained contains van der Waals' equation of state as a special case. H. H. F. H.

**1525.** *Kinetic Explanation of van't Hoff's Law for Osmotic Pressure in Dilute Solutions.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 788–800, May 11, 1905. Proc. 7. pp. 729–741, May 25, 1905.)—Former work is discussed generally, and definitions given of the pressures obtaining in a fluid. An explanation is obtained by a simple consideration of the sphere of action, but a complete treatment of the boundary layer is not attempted or thought to be necessary for this discussion. H. H. F. H.

**1526.** *Osmotic Pressure or Thermodynamic Potential.* **P. Kohnstamm.** (Konink. Akad. Wetensch. Amsterdam, Versl. 13. pp. 800–811, May 11, 1905. Proc. 7. pp. 741–751, May 25, 1905.)—A general discussion which cannot be satisfactorily abstracted. H. H. F. H.

**1527.** *Salt-formation in Solutions of Tautomeric Substances.* **J. W. Brühl** and **H. Schröder.** (Zeitschr. Phys. Chem. 51. pp. 513–541, April 25, 1905. From Verhandl. des Naturhist. Mediz. Vereins at Heidelberg, 8. p. 246, 1905.)—An optical investigation of aceto-acetic ester in water, methyl alcohol, and chloroform. [See also Abstract No. 881 (1905).] D. H. J.

**1528.** *Electrolysis of Fused Salts.* **R. Lorenz.** (Internat. Elect. Congress, Trans. 2. pp. 160–186, 1904. Amer. Electrochem. Soc., Trans. 6. pp. 160–186, 1904.)—A review of the present state of knowledge on this subject. T. H. P.

**1529.** *Chemical Dynamics of the Reactions between Sodium Thiosulphate and Organic Halogen Compounds.* Part II. *Halogen-substituted Acetates.* **A. Slator.** (Chem. Soc., Journ. 87. pp. 481–494, April, 1905.)—The author investigates the reactions of sodium thiosulphate with ethyl iodoacetate and methyl, ethyl, and sodium bromo- and chloro-acetates, and shows that they are all bimolecular reactions. A table of velocity constants at 25° is given. The dissociation constant of lead thiosulphate is found to have the value $[\mathrm{Pb}^{\cdot\cdot}][\mathrm{S_2O_3}'']/[\mathrm{PbS_2O_3}] = 1{\cdot}5 \times 10^{-4}$. T. H. P.

**1530.** *Oceanic Salt Deposits.* 42. *Formation of Glauberite.* **J. H. van't Hoff.** (Preuss. Akad. Wiss. Berlin, Sitz. Ber. 24. pp. 478–483, May 11, 1905.)—The formation of glauberite from calcium and sodium sulphates—

$$\mathrm{CaSO_4 \,.\, 2H_2O + Na_2SO_4 \,.\, 10H_2O = CaNa_2(SO_4)_2 + 12H_2O},$$

takes place in contact with water above 29° C. In a solution saturated with salt the transition temperature is lowered to 17·9°, and in presence of the salts which would normally accompany it in the evaporation of sea-water, it may be formed at as low as 10° C. T. M. L.

**1531.** *Equilibrium between Sodium and Magnesium Sulphates.* **R. B. Denison.** (Faraday Soc., Trans. 1. pp. 136–139, May, 1905.)—Attempts were made to prepare a *sodium* langbeinite of the formula $\mathrm{2MgSO_4 \,.\, Na_2SO_4}$. It was found that at 59° astrakanite, $\mathrm{Na_2Mg(SO_4)_2, 4H_2O}$, was converted in a solution saturated with $\mathrm{MgSO_4}$ by loss of water into loeweite, $\mathrm{Na_2Mg(SO_4)_2, 2\frac{1}{2}H_2O}$, but no evidence of the formation of the desired salt could be obtained at temperatures up to 90° C.

T. M. L.

**1532.** *The Problem of Colloids.* **E. Jordis.** (Zeitschr. Elektrochem. 11. pp. 285–288, May 12, 1905.)—The author considers that the study of colloids has been too one-sided. A chemical rather than a physical study of the colloids is advocated. [See also Abstract No. 479 (1905).] A. F.

**1533.** *Arsenic Pentoxide as Catalyst in the Formation of Sulphur Trioxide.* **E. Berl.** (Zeitschr. Anorg. Chem. 44. 3. pp. 267–299, March 24, 1905. Tech.-chem. Laborat. des eidg. Polytechnikums, Zürich.)—Arsenic pentoxide is found to act as a catalyst in the formation of sulphur trioxide from the dioxide and oxygen, thus confirming the observation of Lunge and Reinhardt. The velocity of reaction was observed by measuring the diminution in pressure of the gaseous mixture as the reaction proceeds, the catalyst being used in two different forms. The mechanism of the reaction is in accordance with the Nernst-Brunner theory. [See also Abstracts Nos. 239 and 634 (1905).] T. S. P.

**1534.** *Dissociation of Salts of Strychnine, as Revealed by Rotivity.* **J. Minguin.** (Comptes Rendus, 140. pp. 243–245, Jan. 23, 1905.)—The rotatory powers are given of solutions of strychnine and various acids in a mixture of benzyl and ethyl alcohols (1) in equivalent proportions, and (2) with a large excess of acid. As the amount of acid increases, the rotation in many cases changes, approaching a constant value which is termed the *permanent deviation*. This alteration points to a partial hydrolysis or dissociation, which would be greater for a more feeble acid.

W. H. St.

**1535.** *Galvanic Cells Produced by the Action of Light.* **M. Wilderman.** (Roy. Soc., Proc. 74. pp. 369–378, Jan. 23, 1905. From the Davy-Faraday Laboratory of the Royal Institution.)—The chief characteristic of these cells is a period of induction during which, after exposure to light, the e.m.f. of the cell increases, and a period of induction during which, after extinguishing the light, the e.m.f. gradually decays. T. M. L.